W. N. DICKINSON, Jr.
CURRENT CONTROLLING APPARATUS.
APPLICATION FILED OCT. 23, 1905.

987,441. Patented Mar. 21, 1911.

4 SHEETS—SHEET 1.

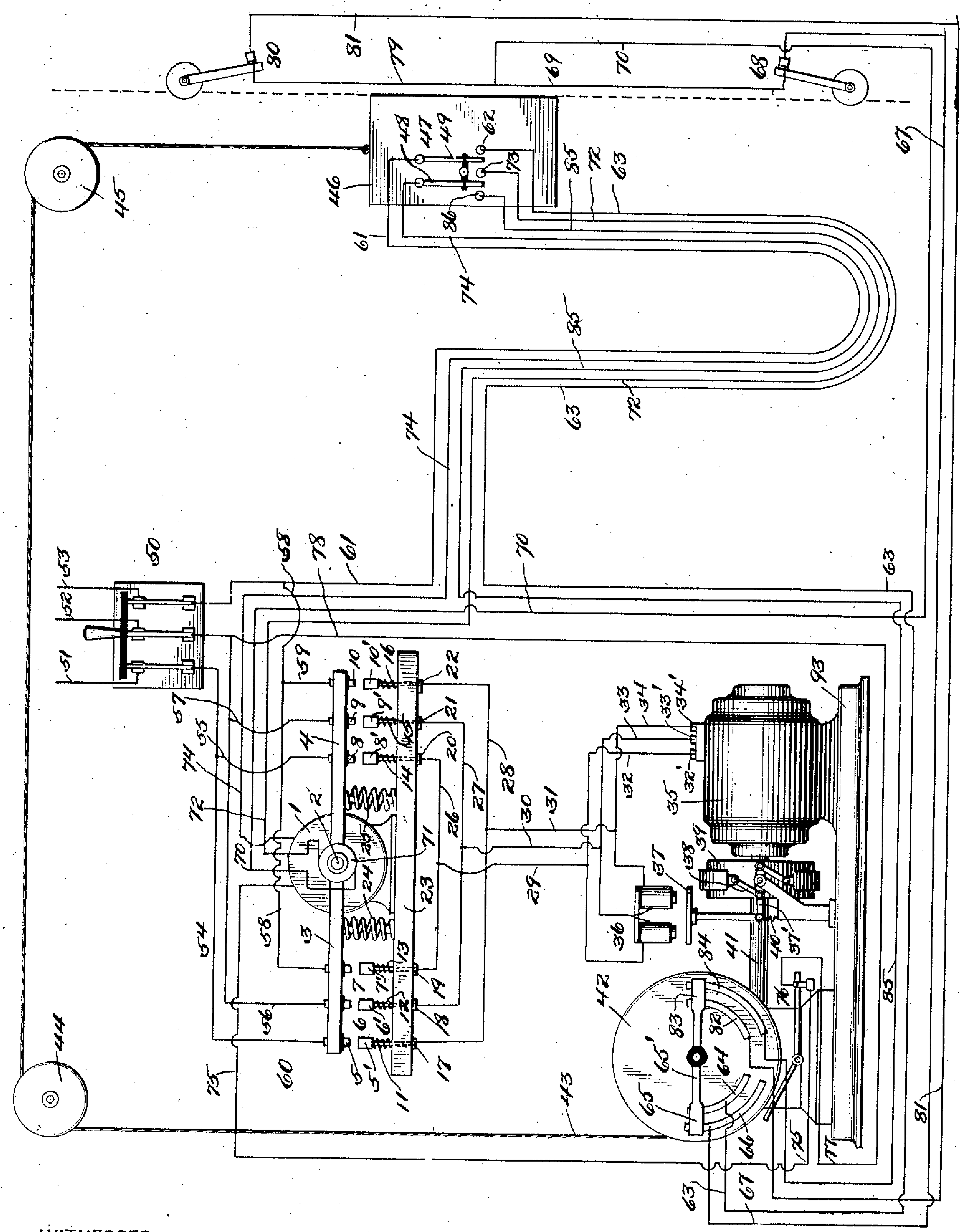

Fig. 1

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Fig. 3

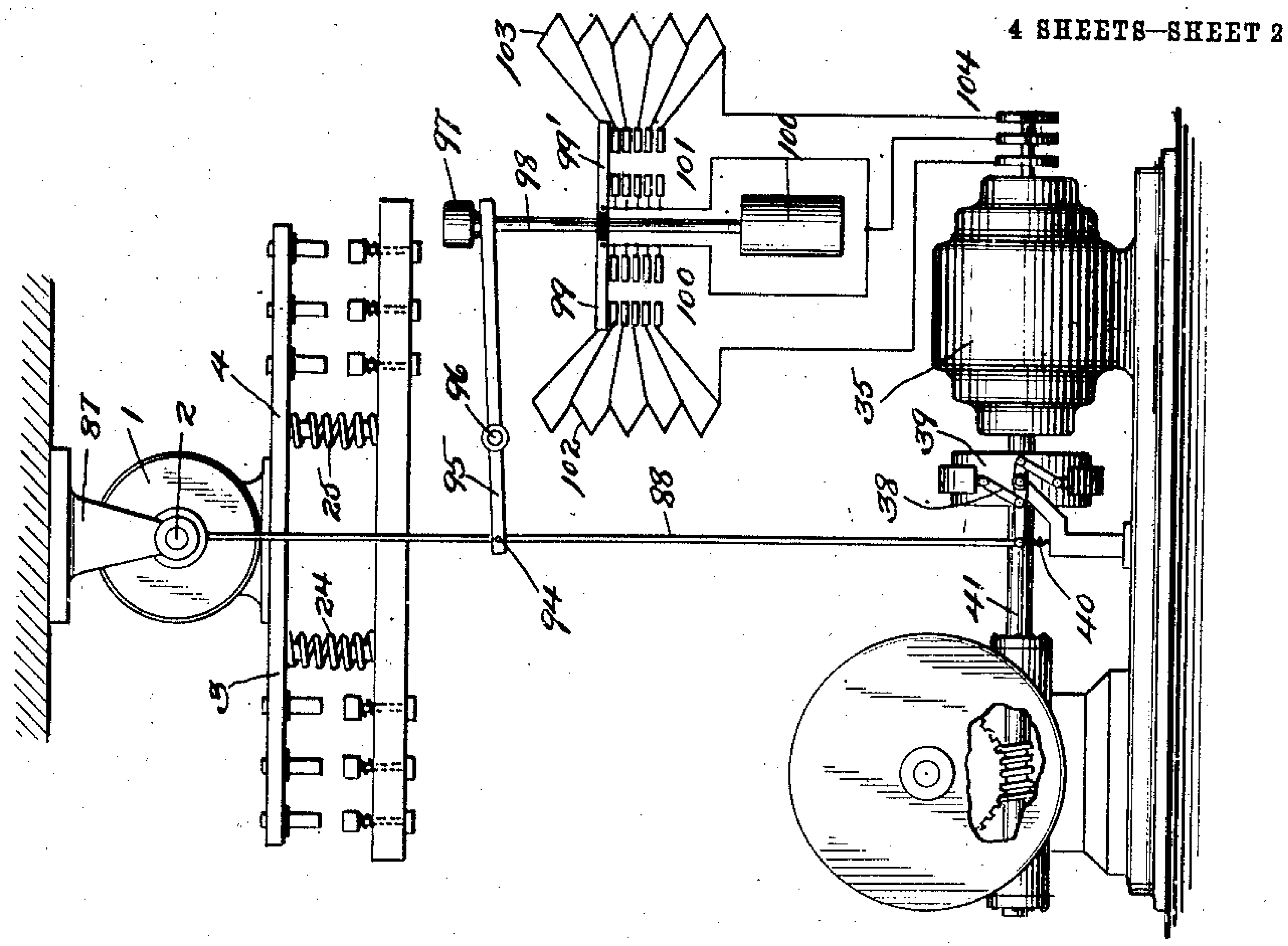
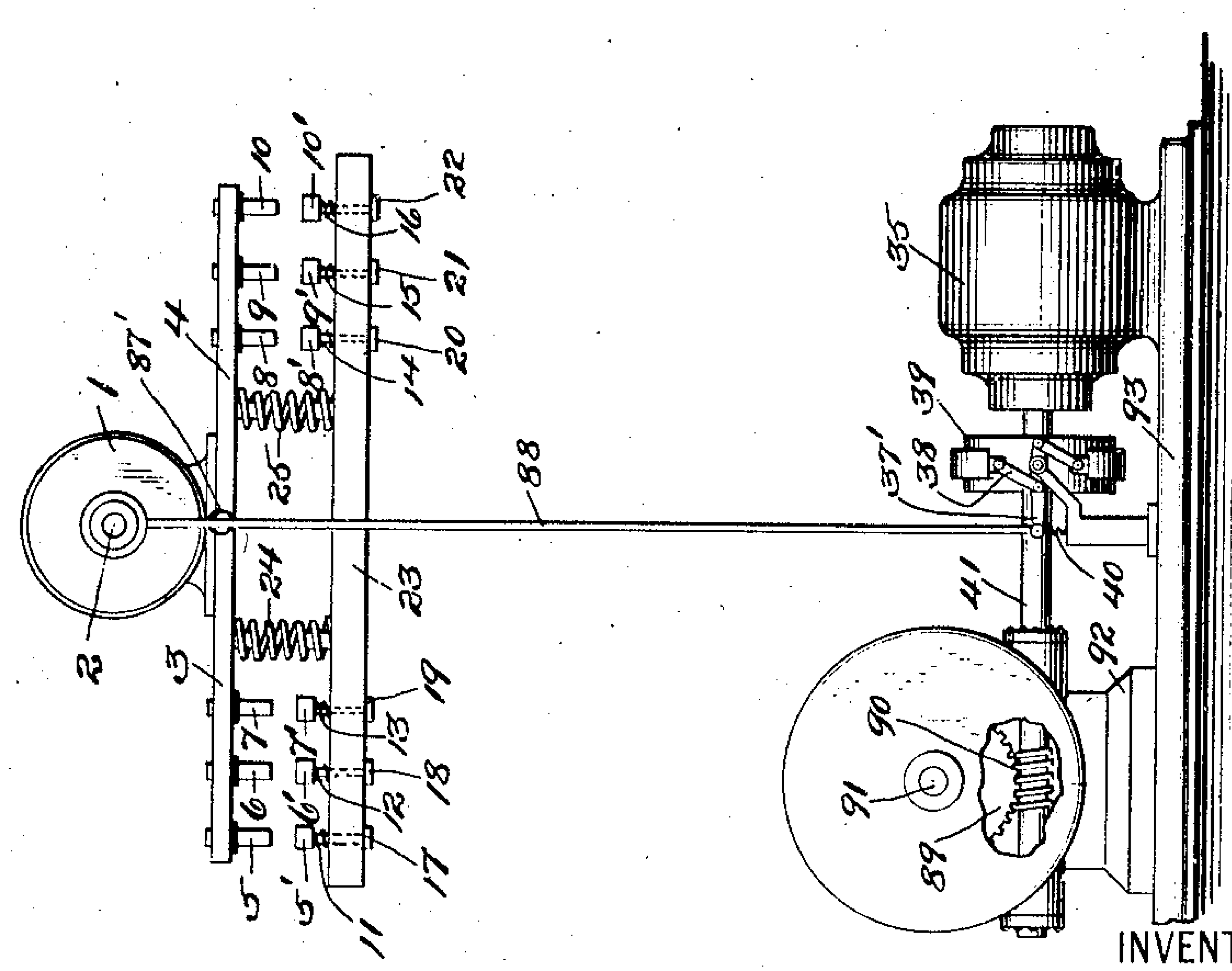


Fig. 2



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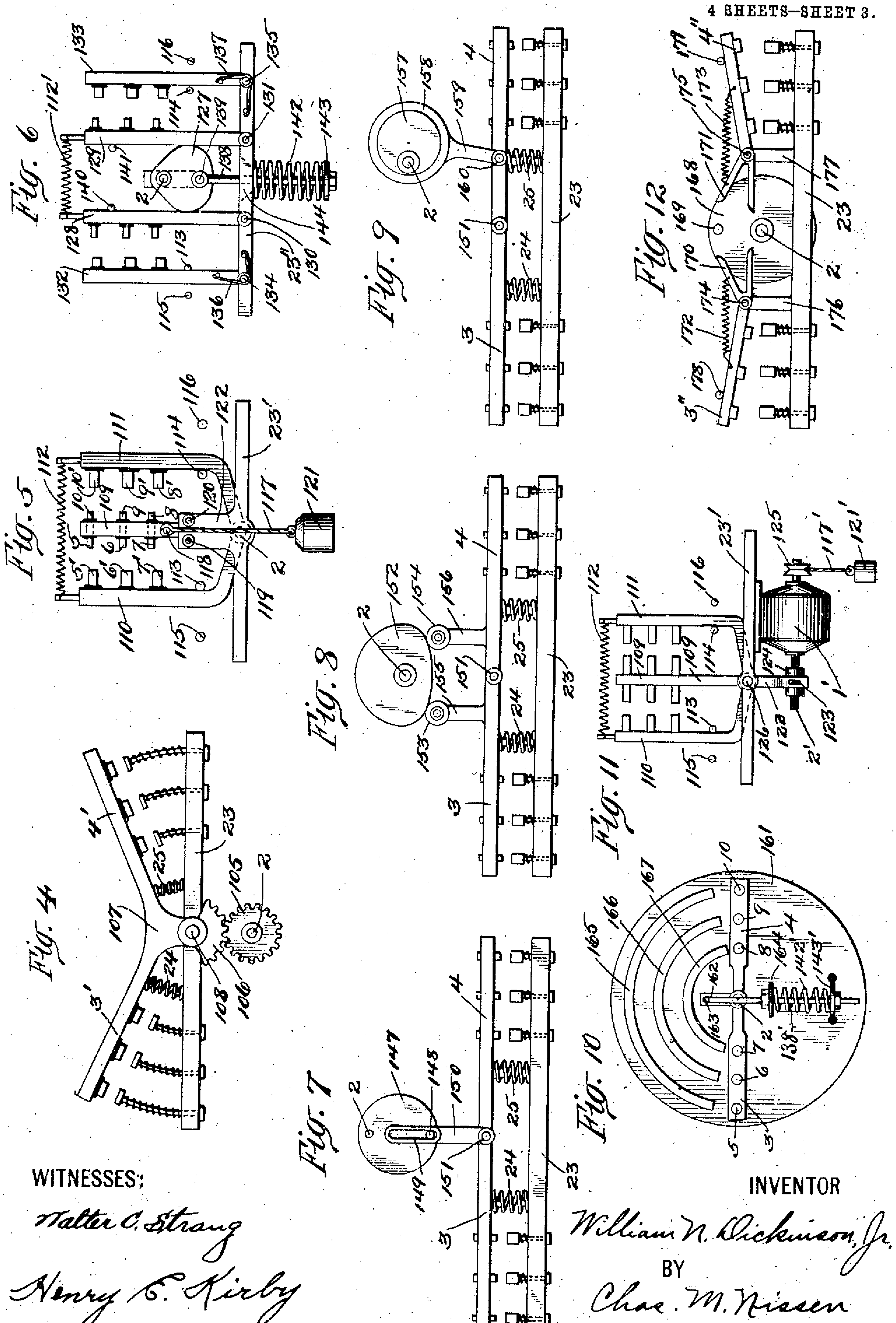

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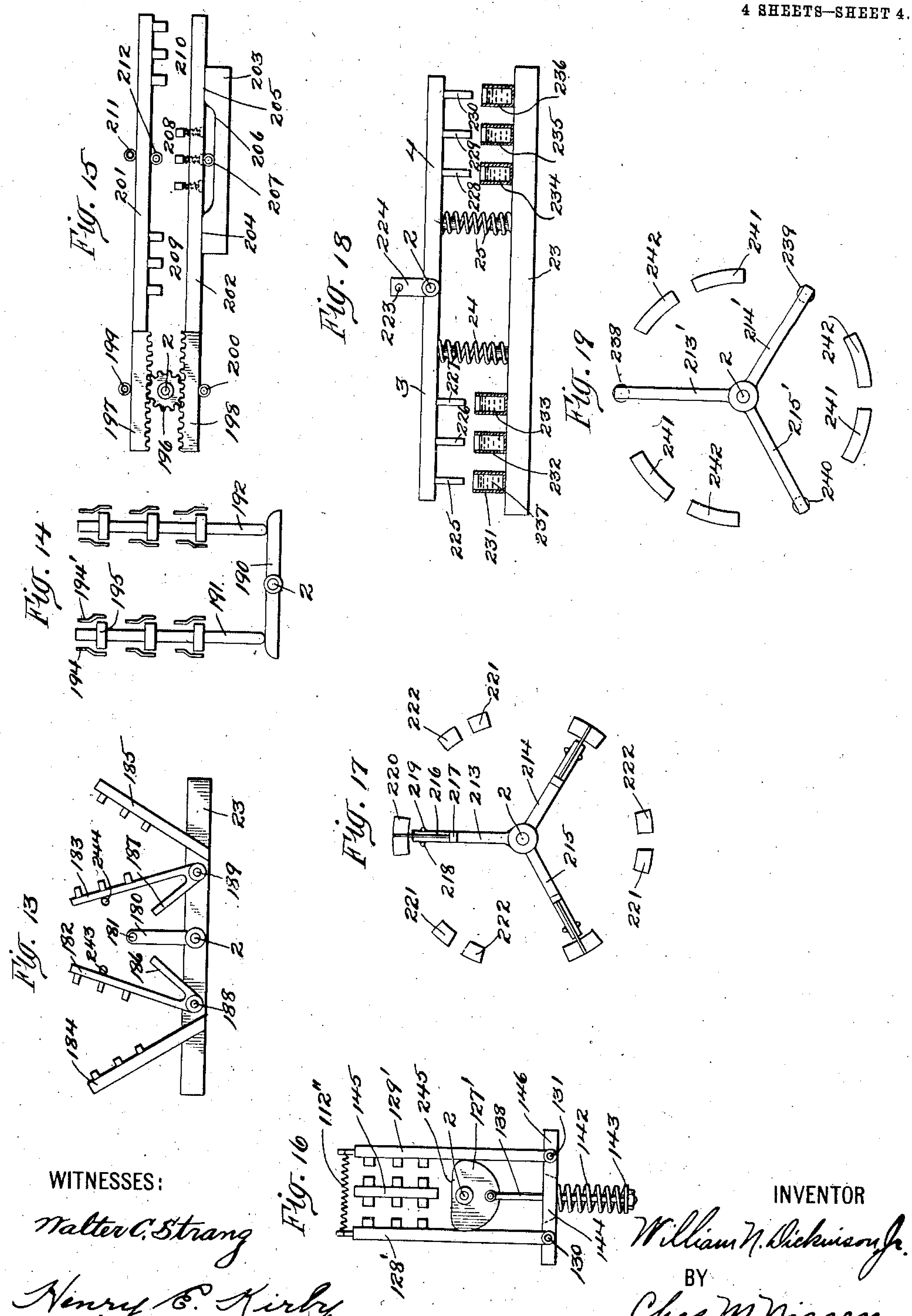

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UNITED STATES PATENT OFFICE.

WILLIAM N. DICKINSON, JR., OF BROOKLYN, NEW YORK, ASSIGNOR TO OTIS ELEVATOR COMPANY, OF JERSEY CITY, NEW JERSEY, A CORPORATION OF NEW JERSEY.

CURRENT-CONTROLLING APPARATUS.

987,441. Specification of Letters Patent. Patented Mar. 21, 1911.

Application filed October 23, 1905. Serial No. 283,938.

To all whom it may concern:

Be it known that I, WILLIAM N. DICKINSON, Jr., a citizen of the United States, residing at Brooklyn, in the county of Kings and State of New York, have invented a new and useful Improvement in Current-Controlling Apparatus, of which the following is a specification.

My invention relates to controlling apparatus for alternating current motors and one of its objects is the provision of simple and efficient means for closing the circuits to an alternating-current motor and maintaining said circuits in closed condition without the production of any chattering noises.

A further object of my invention is the provision of an electric switch for closing alternating current circuits without the production of any chattering noises and to prevent any interruption of said circuits, or objectionable electrical effects due to uncertain or intermittent contacts.

Other objects of the invention will appear hereinafter, the novel combinations of elements being pointed out in the claims.

In the accompanying drawings, Figure 1 represents my invention applied to an elevator system; Figs. 2 and 3 represent modifications thereof, and Figs. 4 to 19 inclusive show details of various modifications of my improved alternating current controlling switch.

Referring to Fig. 1, the reference number 1 designates a small rotary electric motor which is preferably a single-phase alternating-current motor of the direct-current type and is so connected here. 2 designates the motor shaft to which are rigidly secured the lever arms 3 and 4, which carry, respectively, the insulated contacts 5, 6, 7 and 8, 9, 10. These contacts are adapted to engage, respectively, the spring-pressed contacts 5′, 6′, 7′ and 8′, 9′, 10′. Extending downwardly from the contacts 5′, 6′, 7′ and 8′, 9′, 10′ are stems, to the lower ends of which are secured the heads 17, 18, 19 and 20, 21, 22, respectively. The springs 11, 12, 13 and 14, 15, 16 encircle these stems and tend to move the contacts 5′, 6′, 7′ and 8′, 9′, 10′ in an upward direction but this movement is limited by the heads 17, 18, 19 and 20, 21, 22 striking against the under side of the base 23. The motor 1 is herein shown secured to the upper side of the base 23 and on both sides of the motor are comparatively strong springs 24, 25, which normally hold the lever arms 3 and 4 in a horizontal position, as shown. It will now be seen that when the motor is rotated in one direction or the other, either one set of the switches or the other will be closed and held in closed position against the action of either spring 24 or 25. If the motor is rotated in an anti-clockwise direction, the contacts 5, 6, 7, engage respectively the contacts 5′, 6′, 7′ and depress the latter against the action of the springs 11, 12, 13. The current passing through the motor 1 being alternating will tend to vibrate the arm 3 and therefore produce chattering noises and infirm contacts at the switches, but the springs 11, 12 and 13, if sufficiently compressed, allow a small up-and-down movement or vibration of the lever arm 3 and therefore always keep the contacts 5′, 6′, 7′ in firm engagement with the contacts 5, 6, 7, until the motor is deenergized, when the spring 24 will bring the arms 3. 4 back to central position.

The circuits of an electric elevator system are shown in Fig. 1 diagrammatically complete and comprise an alternating-current motor 35, which may be either multi-phase or single-phase. 41 designates the motor shaft which is connected to the hoisting apparatus 42 and which in turn is connected by the hoisting cable 43 over the sheaves 44 and 45 to the elevator car 46. On the shaft 41 is secured the usual brake pulley 39, with which is associated the brake 38 and a spring 40 for applying said brake. This spring is herein shown as an extension spring but in practice a compression spring would be employed. The brake-releasing means comprises an alternating current magnet 36 and an armature 37, which is connected to the brake lever 37′. Whenever the main line switch 50 is closed and the motor 1 energized to move in one direction or the other, circuits will be closed to the brake magnet 36 as well as to the motor 35. The brake will therefore be released and the motor started to move the hoisting drum and car as desired. If the motor 1 moves the switch arm 4 to closed position the motor's circuits may be traced as follows: One circuit starts from the main 51 and passes through the switch

50 and thence by wire 55 leads to contacts 8, 8′, wire 26, wire 29 and wire 32 to motor terminal 32′. Another circuit extends from main 52 through the switch 50 and by way of wire 57 to and through contacts 9, 9′, wires 27, 30 and 33 to motor terminal 33′. The third phase circuit extends from main 53 to switch 50 and by way of wires 58 and 59 to and through contacts 10, 10′, wires 28, 31 and 34 to terminal 34′. If the motor 1 moves the switch arm 3 to closed position, the phases from mains 51 and 53 will be reversed between the motor terminals 34′ and 32′ thus reversing the hoisting motor 35. Means for controlling the direction of movement of the motor 1 in this instance comprises a double pole switch 47 in the car, which, when moved on to the contacts 73, 62, will close a single phase circuit through the auxiliary motor 1, which may be traced as follows: From main 53 to and through switch 50, wire 61, lever 49 of switch 47 to contact 62, wire 63, arc-shaped contact-strip 64 which is mounted on an insulating-plate 42, preferably of slate and mounted in fixed position adjacent the hoisting drum: from contact-strip 64 the circuit continues through wiper 65 which is connected to the left-hand end of the arm 65′ which is suitably connected by the usual stop-motion mechanism to the hoisting-drum shaft; the wiper 65 being in contact with both the strips 64 and 66 the circuit extends further by wire 67 to the hatch limit switch 68 and thence through wires 69 and 70 to the armature 71 of the motor 1; from the motor-armature 71 the circuit continues by wire 72 to the contact 73, lever 48 of switch 47, wire 74 to the field of motor 1 and thence through wire 75, slack-cable switch 76, wire 77, to another main, in this instance 52. If the switch 47 had been moved in the opposite direction, that is, onto the contacts 86 and 73, the circuit through the motor would be reversed and the reversing switch 60 would be operated to start the motor 35 in the opposite direction to what it operated before. The circuit in this case would be from main 53 to and through wire 61, lever 49, contact 73, wire 72, armature 71 in reverse direction, wires 70, 79, limit switch 80, wire 81, contact-strip 82, wiper 83, contact-strip 84, wire 85, contact 86, lever 48, wire 74, through the field of motor 1 in the same direction as before, wire 75, slack cable switch 76, wire 77, to the main 52.

Fig. 2 shows a modification of the reversing switch in that the motor 1 is pivotally mounted at 87′ at some point which may be above the elevator machine. In this case the field is movable in one direction and the armature in the opposite direction, the one forming a purchase for the other. The lever arms 3 and 4 are secured rigidly to the motor frame and movable therewith against the action of the centering springs 24, 25, which, as in Fig. 1, are placed between said arms 3 and 4 and the fixed base 23. At a suitable point on the motor armature or to the armature shaft is secured a flexible strap 88, which is connected to the brake lever 37′ and operates to release the brake whenever either switch arm 3 or 4 is moved to circuit-closing position. Further details illustrated in Fig. 2 are the worm 90 and worm-wheel 89, the latter being secured to the hoisting-drum shaft 91. The strap 88 being connected to the armature or its shaft at a point below the axis of the armature, when the parts are in the position shown, the strap 88 will always be drawn upward to release the brake when the armature is rotated. The motor brake and hoisting drum are shown mounted on a bed-plate 93, the support for the hoisting drum being designated by the reference number 92. Inasmuch as the field frame is movable in one direction and the armature in the opposite direction, the one forming the purchase for the other, the switch arms and the brake strap 88 may be interchanged if desired with respect to their being connected to the moving parts of the motor. That is, the arms 3 and 4 in Fig. 2 may be connected to the motor frame 1 and the strap 88 connected to the armature or armature shaft to wind thereon as shown in Fig. 2, or the strap 88 may be connected to the frame 1 and the arms 3 and 4 to the armature shaft. In any event it should be noted that a single torque action produces an economical operation in effecting the release of the brake apparatus against the action of the spring 40 and the closing of one portion of the reversing switch against the action of the spring 24 or spring 25. The torque action which in Fig. 1 is taken up by the fixed motor frame, is utilized in Figs. 2 and 3 to release the brake without requiring any greater power in the pilot motor. The principle involved is that of reaction in the contrary direction which is taken advantage of in producing an economical result.

Fig. 3 is similar to Fig. 2 with the addition of means for gradually increasing the speed of a two-phase induction motor, these means comprising sectional resistances 102 and 103 connected to contacts 100 and 101 respectively. Over these contacts are adapted to move the bridging pieces 99, 99′ to gradually cut out said resistances as the motor 35 starts from rest and increases to full speed. The bridging pieces 99, 99′ are secured to but insulated from the rod 98 to the upper end of which is secured a weight 97 and to the lower end of which is connected a dash-pot 100. Now, when the motor 1 is rotated in one direction or the other, the lever 95, which is pivoted at 96, will be moved by the rod or flexible strap 88, said rod being connected at 94 to said lever 95. This operation will release the weight 97 which is normally held in its uppermost position by the spring 40, acting through the rod 98 and lever 95. When the weight 97 and consequently the bridging pieces 99 and 99′ are thus released, the latter will slowly descend, being retarded by the dash-pot 100, to gradually cut out the starting resistances 102 and 103, which are connected to the slip rings 104 of the rotor of the motor 35.

In Fig. 4 I have illustrated a pinion 105, secured to the motor shaft 2 and a segment gear 106 meshing with said pinion. This gear is rigidly secured to the lever 107, which is pivoted to the base 23 at 108 and comprises the arms 3′, 4′. 24 and 25 are the centering springs. The stems for the spring pressed contacts are shown arc-shaped to correspond with the movement of the contacts on the arms 3′, 4′.

In Fig. 5 I have shown two arms, 110 and 111, independently pivoted to the base 23′ and normally held against the stops 113 and 114 respectively by the spring 112. Secured to the motor shaft 2 is the arm 109, to which is fastened at 118 a strap or rope 117, to the lower end of which is attached a weight 121. When the motor is energized to move the same in a clockwise direction the contacts 8, 9, and 10 will engage the contacts 8′, 9′, 10′ respectively on the arm 111 and move said arm against the stop 116. If the arm 109 is moved in the opposite direction the contacts 5, 6, 7 will engage the contacts 5′, 6′, 7′ respectively and move the arm 110 against the stop 115. The weight 121 always has a vertical movement by reason of the engagement of the rope 117 with the anti-friction rollers 119 or 120, which are mounted on the upper end of an extension 122 of the fixed base 23′. When the motor is deenergized the weight will act to return the arm 109 to central position, thus opening the switch.

Fig. 11 is a modification of Fig. 5, in that a small motor 1′ having a screw-threaded shaft 2′ moves the trunnion nut 124, when said motor is energized. This nut has a pin and slot connection with the arm 122, which is pivoted at 126 to the fixed base 23′ and is rigidly connected with the normally vertical arm 109. As in Fig. 5, when the motor 1′ is energized the arm 109 is moved in one direction or the other to move the arm 110 or 111 against the stop 115 or 116, respectively.

It should be noted that when the construction shown in Fig. 5 or Fig. 11 is used the spring 112 acts to keep the contacts in firm engagement as well as to prevent chattering as any vibration due to the variation in the strength of the motor having the shaft 2 or 2′, is taken up by said spring.

In Fig. 6 are shown two contact-carrying levers 128 and 129 normally held against the stops 140 and 141 respectively by the spring 112′. These levers are pivoted to the fixed base 23″ at 130 and 131. Between the levers is placed a cam 127 of peculiar shape and secured at its upper portion to the shaft 2 of the motor. To the lower portion of this cam is pivoted at 139 the rod 138, which carries at its lower end plate 143. Between this plate and the base 23″ is a spring 142 for returning the cam 127 to normal or central position as shown. When the auxiliary motor 1 is energized to rotate the shaft 2 and therefore move the cam 127 against the action of the spring 142, the lever 128 or 129 will be moved against the action of the spring 112′ so that the contacts carried by said levers will engage the contacts carried by the lever 132 or 133. The cam 127 is so designed that the levers 132 and 133 shall be moved against the stops 115 and 116 respectively against the action of the springs 136 and 137, which normally maintain said levers 132 and 133 against the stops 113 and 114. A V-shaped recess 144 is placed in the base 23″ to allow free movement of the rod 138. It should be noted that when either the left-hand or right-hand switch is closed, not only do the springs 136 and 137 maintain the contacts in firm engagement even though there be some vibration of the shaft of the auxiliary, alternating current motor but the cam also allows of a limited movement of said shaft without producing any movement of the levers 128 or 129. This is accomplished by having the lower portion or face of the cam 127 flattened as shown.

In Fig. 7 I have shown a disk 147 secured to the auxiliary motor shaft 2 and provided near its periphery at the opposite side from said shaft with the laterally projecting pin 148 which is adapted to engage in a slot 149 at the upper end of the arm 150. This arm is pivoted at 151 and rigidly secured to the contact-carrying arms 3 and 4, which, as in Figs. 1, 2 and 3, are normally maintained in circuit-opening position by the springs 24 and 25. 23 designates a fixed base carrying the spring pressed contacts which coöperate with the contacts carried by the lever arms 3 and 4.

In Fig. 8 I have shown a cam 152 secured to the motor 2 and adapted to oscillate the arms 3 and 4 about the fixed pivot 151; when said cam is moved in one direction or the other, the cam 152 acts against the anti-friction rollers 153 and 154 which are mounted in the upper ends of the supports 155 and 156, respectively, which are secured to the arms 3 and 4. As before springs 24 and 25 are employed for centering the arms 3 and 4 when the auxiliary motor is deënergized.

In Fig. 9 an eccentric disk 157 is secured to the auxiliary motor shaft 2 and operates to move the switch arms 3 or 4 to circuit-closing position through the eccentric strap

158 and the eccentric rod 159, the latter being pivoted at 160 to the arm 4; it is obvious that if the shaft 2 is moved through an arc of about 90 degrees the shaft 2 may have a certain oscillatory vibration due to the alternating current operating the auxiliary motor without injuriously affecting the firm engagement of the circuit closing contacts.

In Fig. 10 the switch arms 3 and 4, carrying the contacts 5, 6, 7, and 8, 9, 10, respectively, are rigidly secured to the motor shaft 2. The said contacts are adapted to be moved by the auxiliary motor into contact with the arc-shaped conducting strips 165, 166 and 167 which are mounted on the disk 161 of insulating material, preferably slate. To the central portion of the double-armed lever 3, 4 is secured the extension 162 which is pivoted at 163 to the upper end of the rod 138. This rod may be fastened to either the plate 164 or 143′ the other plate then being pivoted as at 43 to the base plate 161 and allowing free movement of the rod 138′. The spring may therefore be either a compression or an extension spring. When the auxiliary motor moves the shaft 2 in one direction or the other either the contacts 5, 6, 7 or the contacts 10, 98, 8 will engage, respectively, with the conducting strips 165, 166 and 167. It is evident that with this arrangement a large degree of oscillatory vibration of the motor shaft 2 is allowed without disconnecting the contacts and strips. When the auxiliary motor is deënergized the spring 142′ acts to return the arms 3 and 4 to central or normal position, as shown. If desired the conducting strips 165, 166 and 167 may be disconnected at some point near the upper central portion of the disk so that there may be two sets of conducting strips insulated from each other and corresponding respectively with the contacts 5′, 6′, 7′, and 8′, 9′, 10′ shown in Fig. 1. Furthermore, it may be preferable in some instances to have the contacts 5, 6, 7, and 8, 9, 10 spring pressed when the construction shown in Fig. 10 is employed.

In Fig. 12 I have shown a disk 168 secured to the motor shaft 2 and provided with a laterally projecting pin 169 near the periphery of said disk and substantially vertically above the motor shaft 2 when in normal position. This pin is adapted to engage with the arms of the V-shaped levers 170 and 171 which are pivoted respectively at 174 and 175 to supports 176 and 177 secured to the fixed base 23. Springs 172 and 173 connect the upper arms of the V-shaped levers 170 and 171 with the contact-carrying arms 3″ and 4″, respectively, and hold said arms against the fixed stops 178 and 179. With this arrangement, if the auxiliary motor is energized to move the disk 168 a little over 90 degrees in one direction or the other, either the lever 170 or 171 will be moved to its lowermost position, in which case the spring 172 or 173 will pass below the pivotal points 174 or 175 and therefore act to move and hold the switch 3″ or 4″ in its lowermost of contact-engaging position. It should be noted that with this arrangement, furthermore, a spring 172 acts to hold the contacts in an engaging position independently of the motor; the contacts are therefore held in positive engagement with each other and all chattering and liability of infirm contacts are avoided. When the motor is deënergized and returned to central position by a weight or spring as shown for example in Fig. 5 or 6, the pin 169 strikes the upper arm of the lever 170 or 171 and moves the spring 172 or 173 and consequently the arm 3″ or 4″ back to its original position.

In Fig. 13 an arm 180 carrying a pin 181 at its upper end is secured to the motor shaft 2 so that when the motor is operated in one direction or the other the pin 181 will strike against the arm 182 or 183 and throw the same to circuit-closing position against the inclined fixed contact-carrying support 184 or 185; in this case the contacts are held in engagement by gravity. Upon the return of the arm 180 to central position the pin 181 will strike against the arm 186 or 187 to return the lever 182 or 183 to its normal position against the stop 243 or 244 where it is also held by gravity. The levers 182 and 183 are respectively pivoted at 188 or 189 to the fixed base 23, to which are also secured the fixed contact carriers 184 and 185. As in Fig. 12, so also in Fig. 13, the contacts are held in engagement with each other positively and independently of any vibrations of the motor shaft.

Fig. 14 illustrates a further modification in which a double-arm lever 190 may move the vertical contact carriers 191 or 192 to circuit-closing position by the engagement of the contact 195 with fixed contacts 194 and 194′. With this arrangement a certain vibration of the motor shaft is allowed without interrupting the circuits through the circuit closers, in that the fixed contacts 194 and 194′ have an extended vertical portion up and down which the contact 195 may move without interfering in any way with the continuity of the circuits therethrough.

In Fig. 15 the construction shown consists of a pinion 196 fixed to the motor shaft 2 and engaging two racks 197 and 198, to which are secured the contact-carrying rods 201 and 202, respectively. The racks are held in mesh with the pinion by the anti-friction rollers 199 and 200 and the rod 201 is limited to a straight line movement by the anti-friction rollers 211 and 212. To the lower side of the rod 202, preferably below the spring pressed contacts 208, is suitably mounted an anti-friction roller 207, which is adapted to engage the recess cam

206 in the fixed support 203. When the auxiliary motor is operated in one direction the upper rod 201 is moved to the right and the lower rod 202 to the left until the roller 207 rides up on the flat portion 204 of the support 203 and brings the spring-pressed contacts 208 into engagement with the contacts 209. When the motor is operated in the opposite direction the rod 201 is moved to the left and the rod 202 to the right until the roller 207 rides up on the flat portion 205 of the support 203 and brings the contacts 208 into engagement with the contacts 210. Here, it should be noted that as long as the roller 207 is on either of the flat portions 204 or 205 and the switches in the circuit-closing position a certain amount of longitudinal vibration of the rods 201 and 202 may be permitted without effecting even the slightest disengagement of the circuit-closing contacts with each other.

Fig. 16 illustrates a modification of Fig. 6; only two movable levers are, however, employed, namely, those designated, 128′ and 129′, pivoted respectively to the fixed base 146 at 130 and 131 and held against the cam 127′ by means of the spring 112″ at the upper ends of said levers. The cam 127′ is provided with a flattened face 245 on its upper side so that when the shaft 2 is moved against the action of the spring 142, either 128′ or 129′ is brought to circuit closing position. It should be noted, however, that one face of the cam 127′ is concentric and the flat face 245 is at such a distance from the shaft 2 that when the latter is rotated through an arc to about 90 degrees either the arm 128′ or 129′ is released so that the contacts carried thereby will be brought into engagement with the fixed contacts on the support 145 through the action of the spring 112″. The contacts carried by the arm 128′ or 129′ engage the fixed contacts a short time before the shaft 2 has made its complete movement so that in its limiting position the cam 127′ will have its flat face 245 substantially parallel with the lever 128′ or 129′ which is in circuit-closing position but out of contact therewith. This construction of course allows of a certain vibration of the motor shaft, the extent of which may be varied as desired by varying the dimensions and arrangement of the cam and levers with respect to the fixed contacts on the support 145.

In Fig. 17 I have shown three arms, 213, 214 and 215 rigidly secured to each other, thus forming a spider, and secured to the auxiliary motor shaft 2. To the outer ends of these arms are connected at 217 the springs 216, which are limited in their movements by stops 218 and 219 and which carry at their extreme outer ends the contacts 220. When the motor is operated in one direction, the contacts 220 engage the fixed contacts 221 and when operated in the other direction the contacts 220 engage the fixed contacts 222. A certain amount of vibration of the motor shaft is here also allowed by the springs 216.

In Fig. 18 the springs 24 and 25 normally maintain the arms 3 and 4 in a horizontal position and consequently the contacts 225, 226, 227 and the contacts 228, 229, 230 out of contact with the mercury 237 in the mercury cups 231, 232, 233 and 234, 235, 236 respectively, which are fastened to the fixed support 23. When, however, the motor shaft 2 and the arm 224 which is secured to the same are moved in one direction or the other the laterally projecting pin 223 on the arm 224 will engage either the switch arm 3 or the switch arm 4 and move the latter to circuit closing position. It will be noticed that the contacts 225, 226, 227 and the contacts 228, 229, 230 are made comparatively long so that when dipped into the mercury cups of corresponding depth considerable vibration of the shaft 2 is allowed without in any way interfering with the continuity of the circuits adapted to be controlled by this improved switch.

In Fig. 19, a spider comprising the arms 213′, 214′ and 215′ is secured to the shaft 2, said arms carrying at their extreme ends the contacts 238, 239 and 240 respectively. The last named contacts are adapted to ride over and be brought into engagement with the arc-shaped strips 242 when the motor is moved in one direction and with the arc-shaped strips 241 when the motor is moved in the other direction. Obviously, the lengths of the arc-shaped strips may be varied as desired depending upon the degree of oscillatory vibrations of the motor shaft which tend to disconnect the circuit-closing contacts. The contacts 238, 239 and 240 may be spring-pressed if desired. It is evident that with the arrangement shown in Fig. 19 the circuit closing contacts and strips are in sliding engagement with each other and a large amount of vibration may be allowed without in any way interfering with the efficiency of the apparatus.

It should be understood that either alternating current circuits or direct current circuits may be controlled by means of my improved circuit closing apparatus which is operated by an alternating current rotary motor and that the arrangement of circuits shown in Fig. 1 illustrates merely one adaptation of my invention.

Although I have shown and described herein a single-phase alternating current motor of the direct current type, I do not wish to be limited thereto, as other kinds of alternating current motors can be used if desired.

Other modifications in the details of my invention and the arrangement of its parts may obviously be made by those skilled in the art without departing from the spirit and scope of my invention.

Having thus described my invention what I desire to have protected by Letters Patent of the United States is:—

1. The combination with an electric motor, of reversing switches therefor, a pilot motor, a fixed support to which the pilot motor is pivoted, switch arms secured to a part of said pilot motor, and a fixed base carrying one set of contacts of each reversing switch.

2. The combination with a motor, of brake apparatus therefor, an additional motor, a switch connected to a moving part of said additional motor, and a connection between said brake apparatus and another moving part of said additional motor.

3. The combination with a motor, of brake apparatus therefor, a secondary motor, an electric switch connected to one of the rotating parts of said secondary motor, and a flexible strap connected between the other rotating part of said secondary motor and the brake apparatus.

4. The combination with an electric motor, of reversing switches therefor, an alternating current pilot motor, a fixed support to which the pilot motor is pivoted, switch arms secured to a part of the pilot motor and carrying the movable contacts of the reversing switch, a fixed base carrying the stationary contacts and yielding means for taking up vibrations at said contacts due to current alternations.

5. The combination with a main motor, of brake apparatus therefor, a pilot motor, a reversing switch for the main motor connected to a moving part of the pilot motor, and a mechanical connection between said brake apparatus and another moving part of the pilot motor.

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

WILLIAM N. DICKINSON, Jr.

Witnesses:
Raymond W. Cherles,
Charles M. Nissen.