Feb. 14, 1933. H. D. SALISBURY 1,897,181

POWER OPERATED SWITCH MECHANISM

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Fig. 1.

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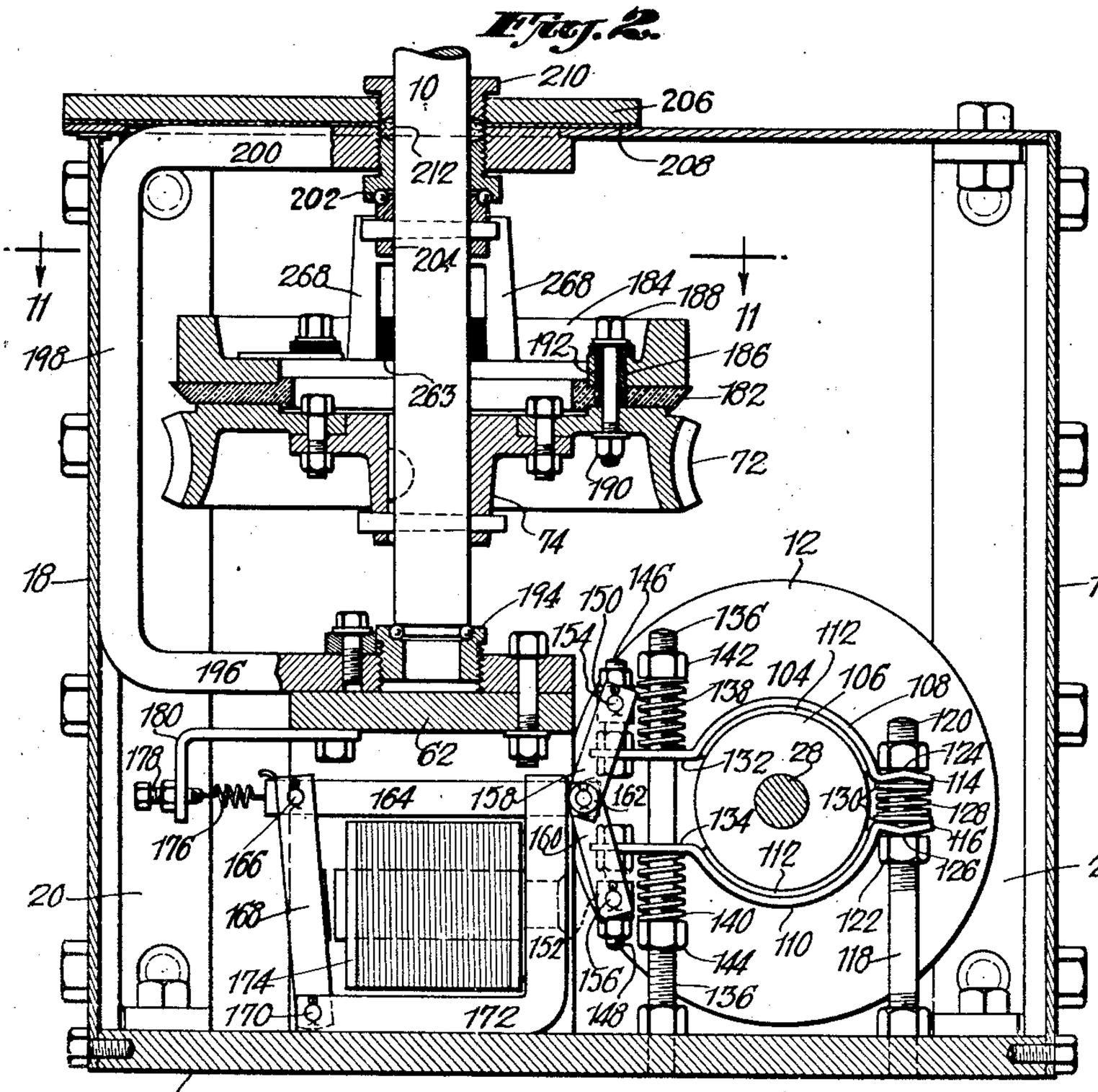
Fig. 2.



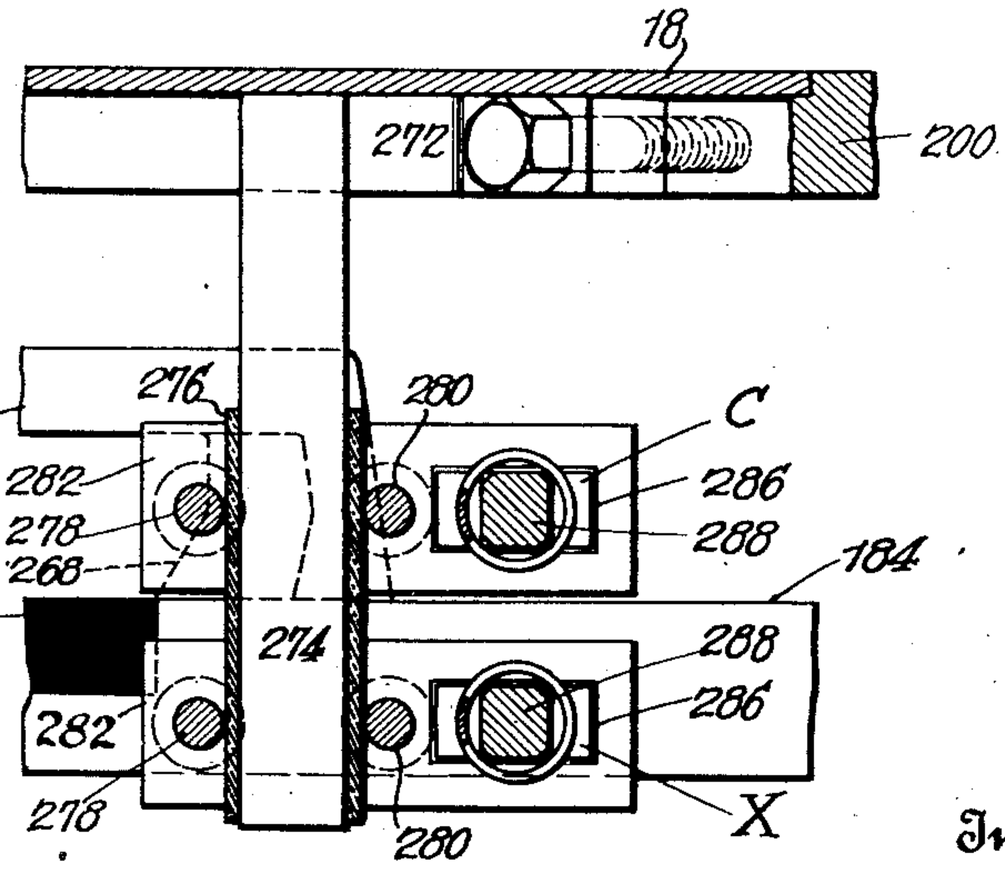


Fig. 12.

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POWER OPERATED SWITCH MECHANISM

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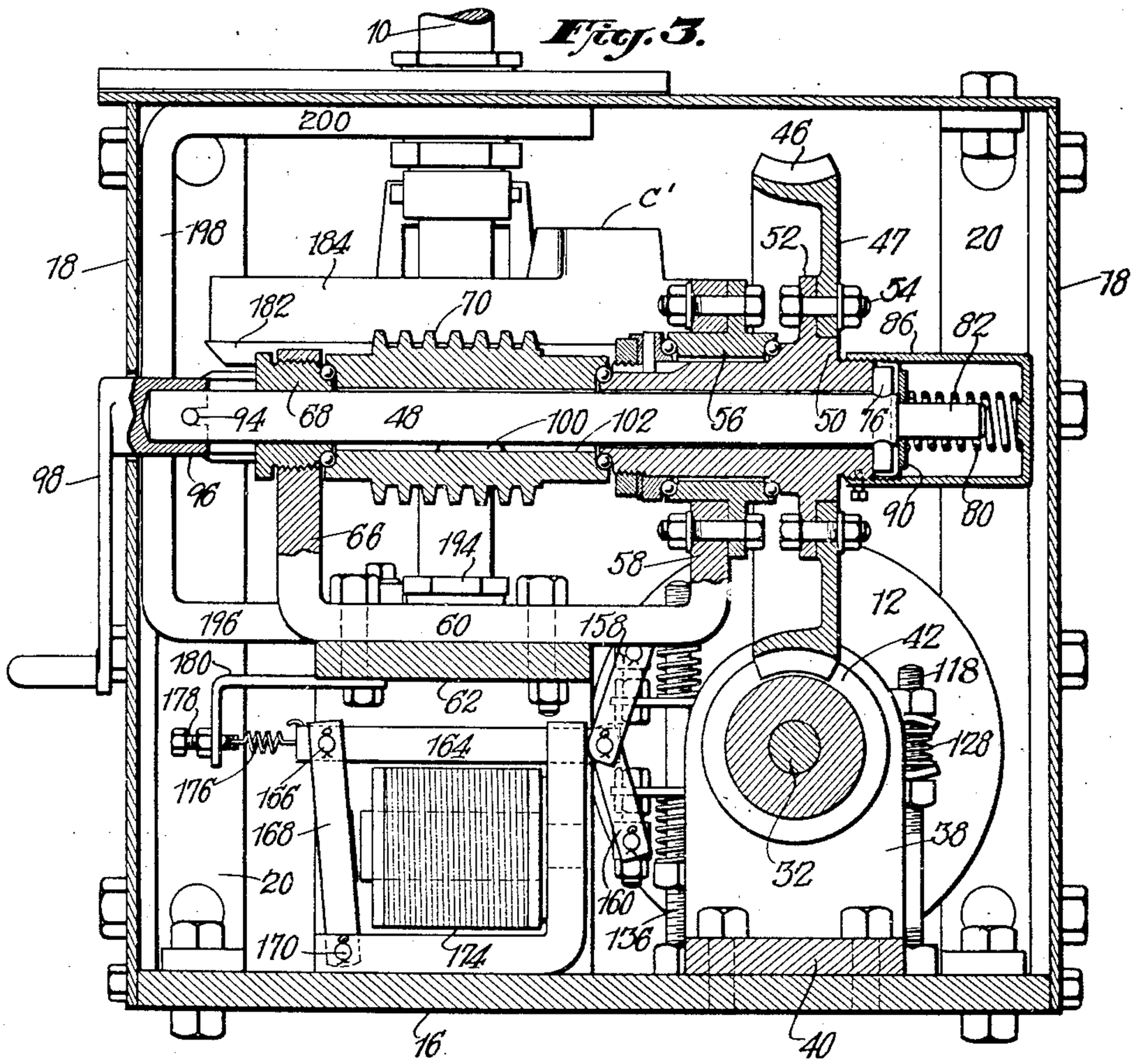
Fig. 3.



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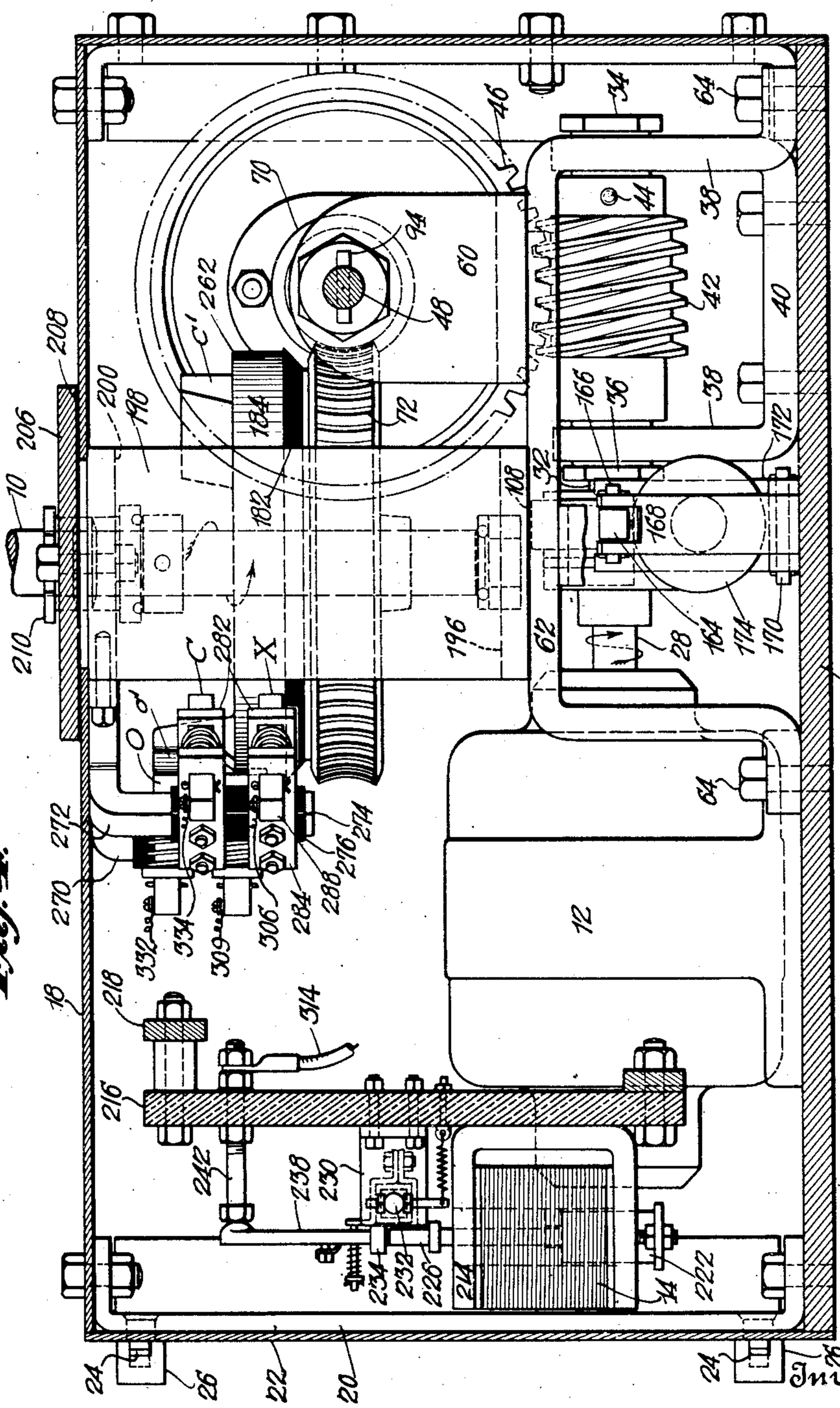

Fig. 4.

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Fig. 10.

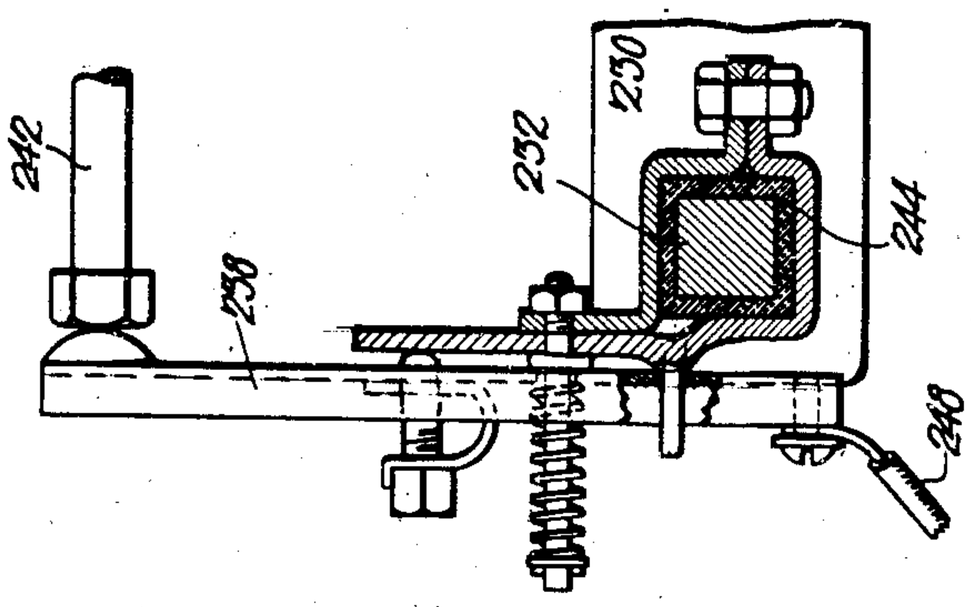

Fig. 9.

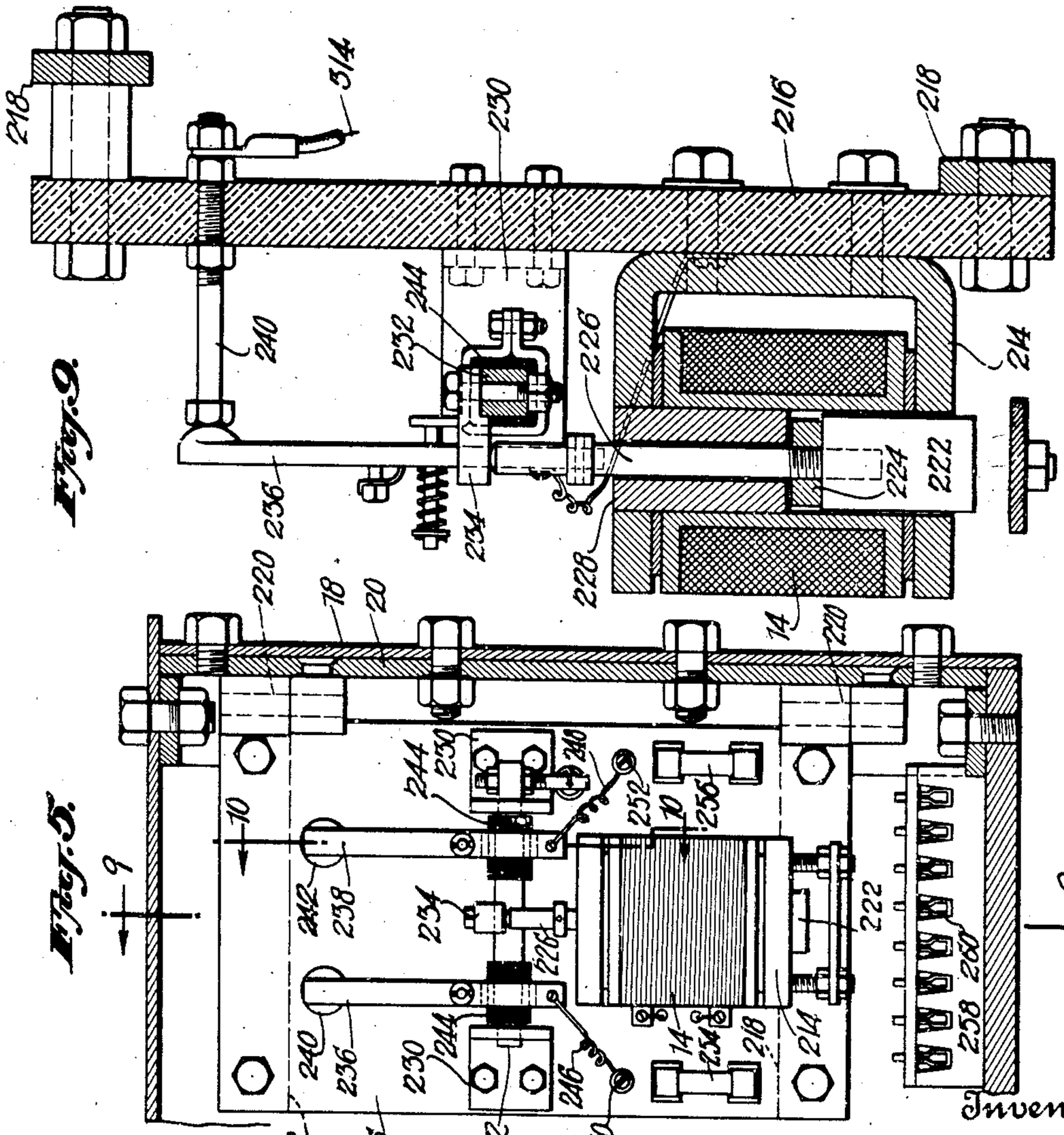

Fig. 5.

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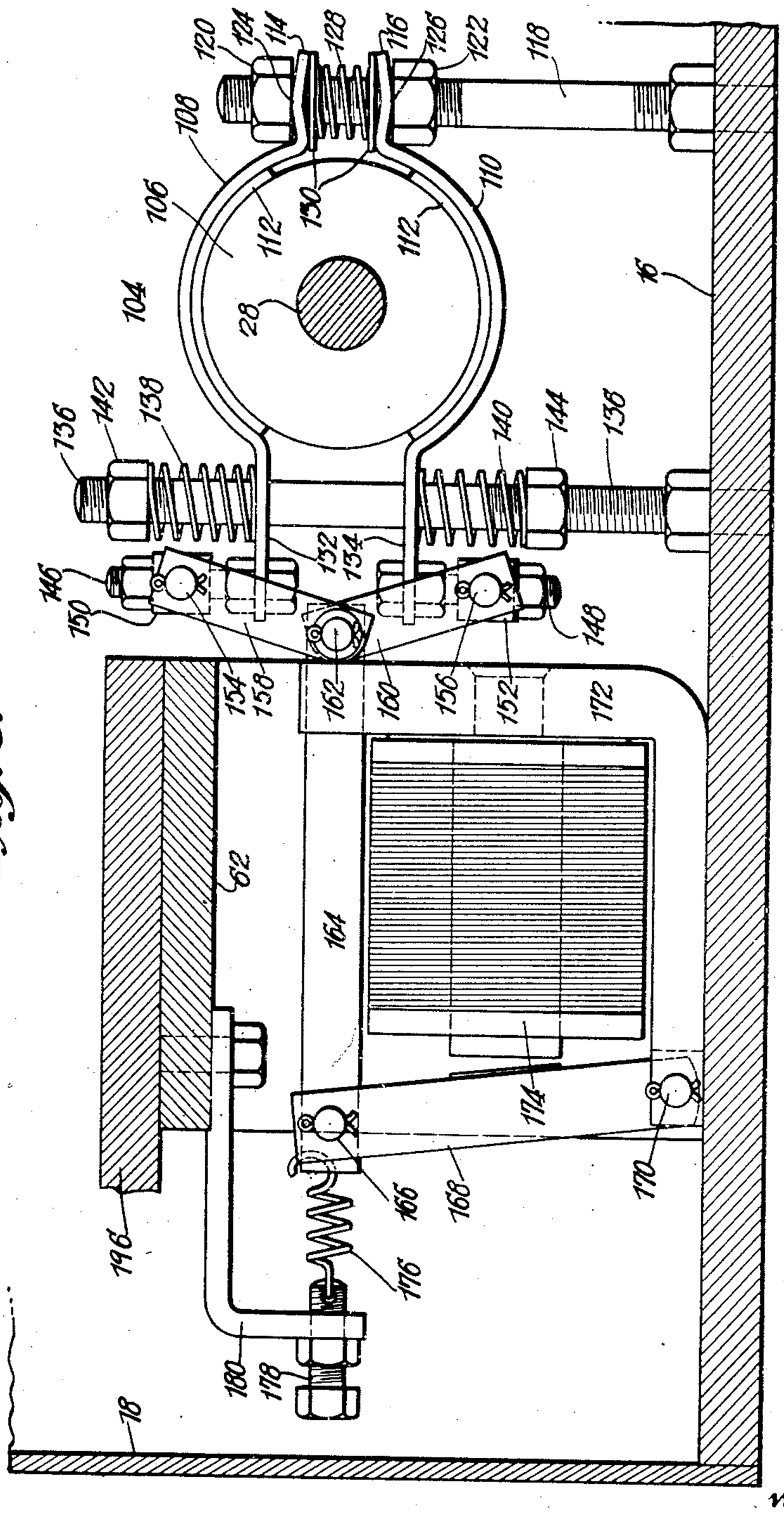

Fig. 6.

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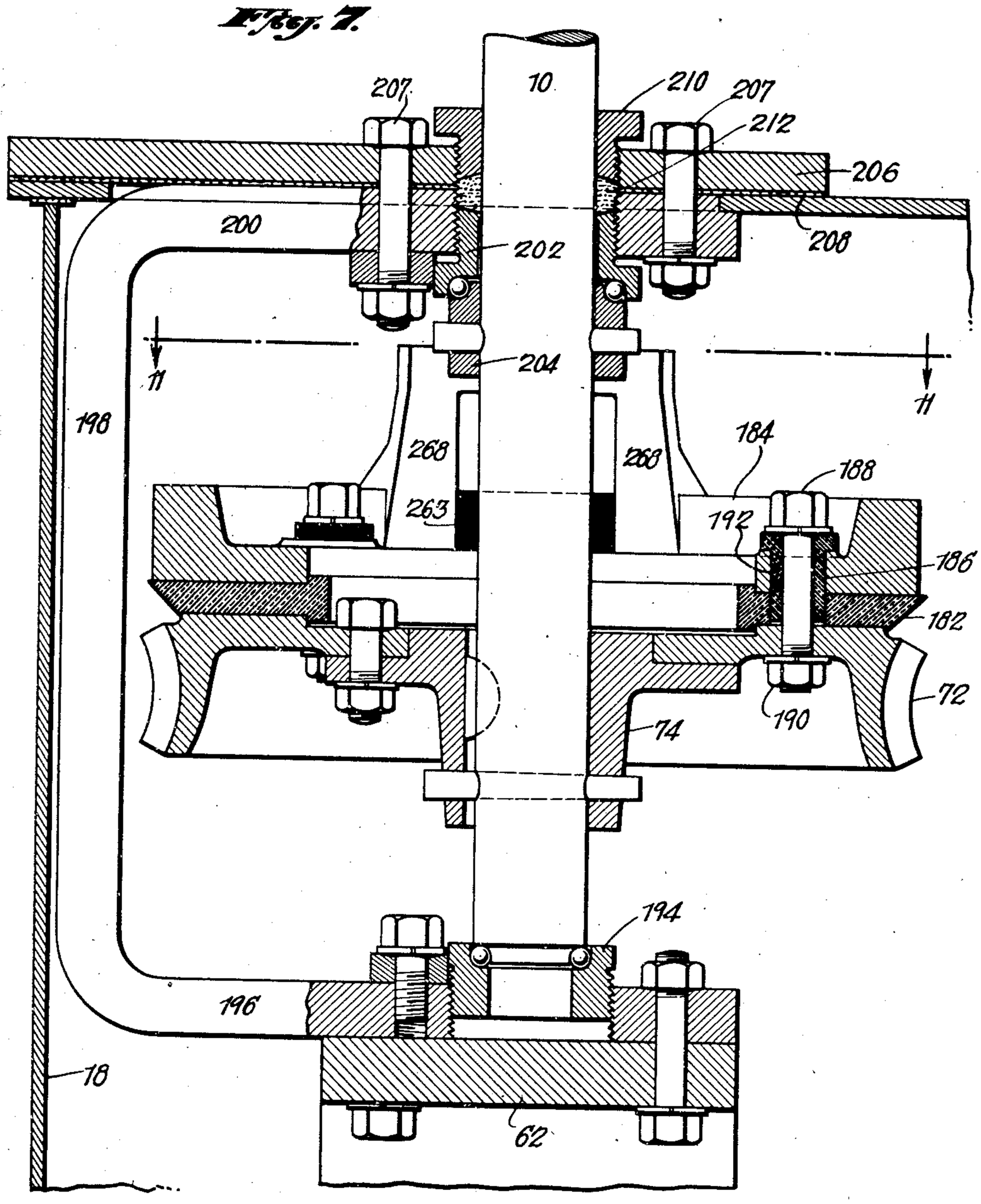
Fig. 7.



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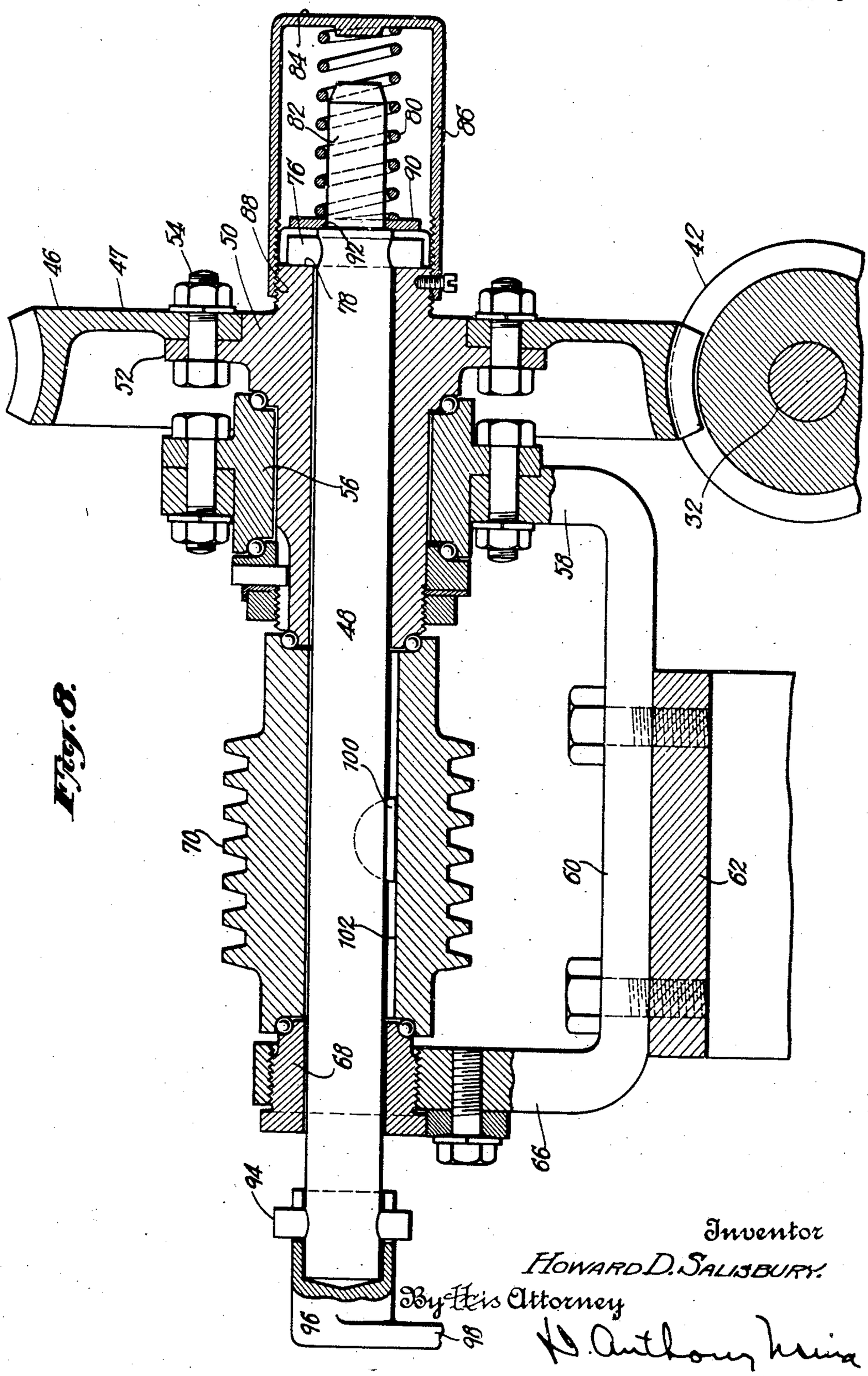

Fig. 8.

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Fig. 11.

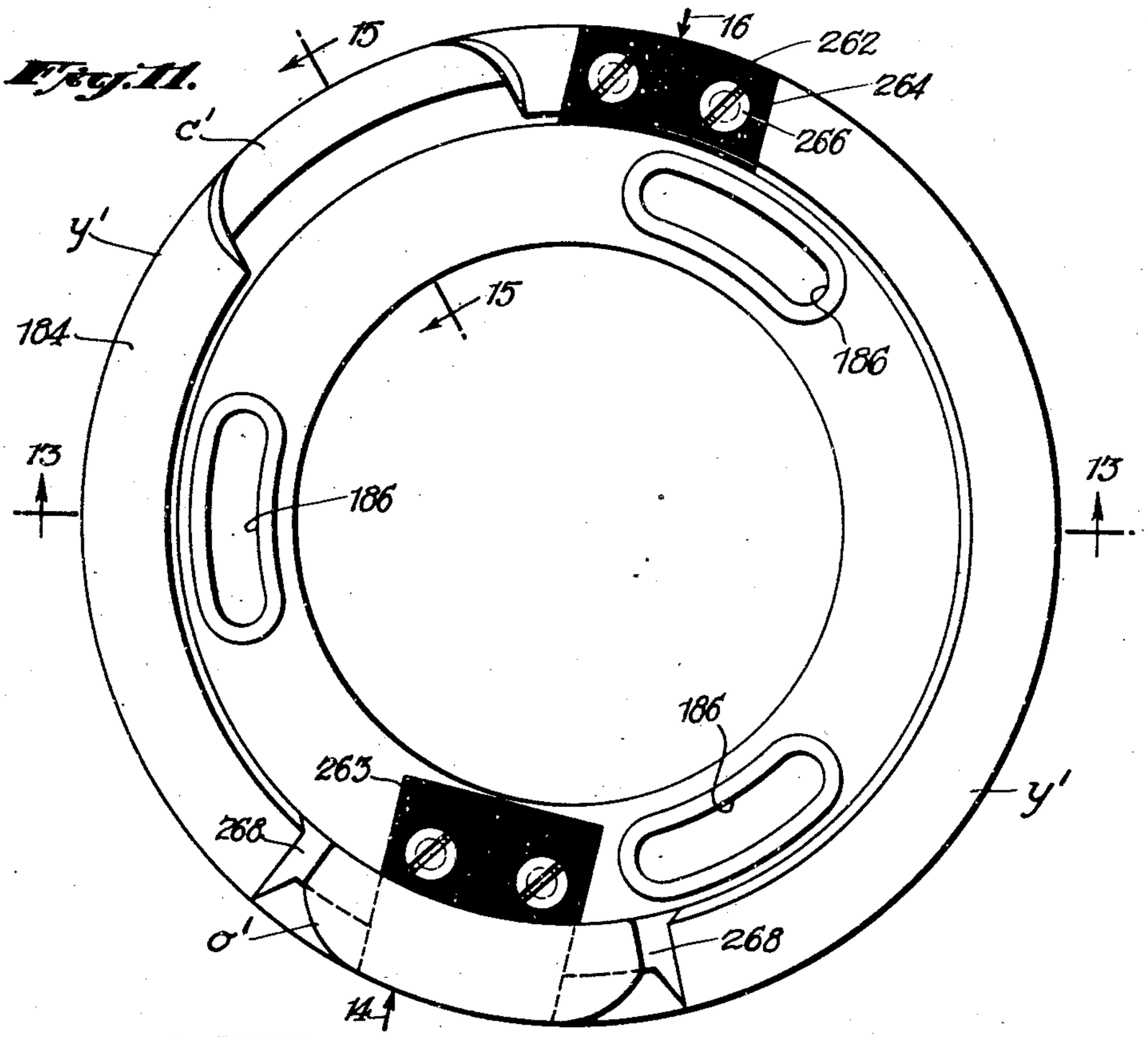


Fig. 13.

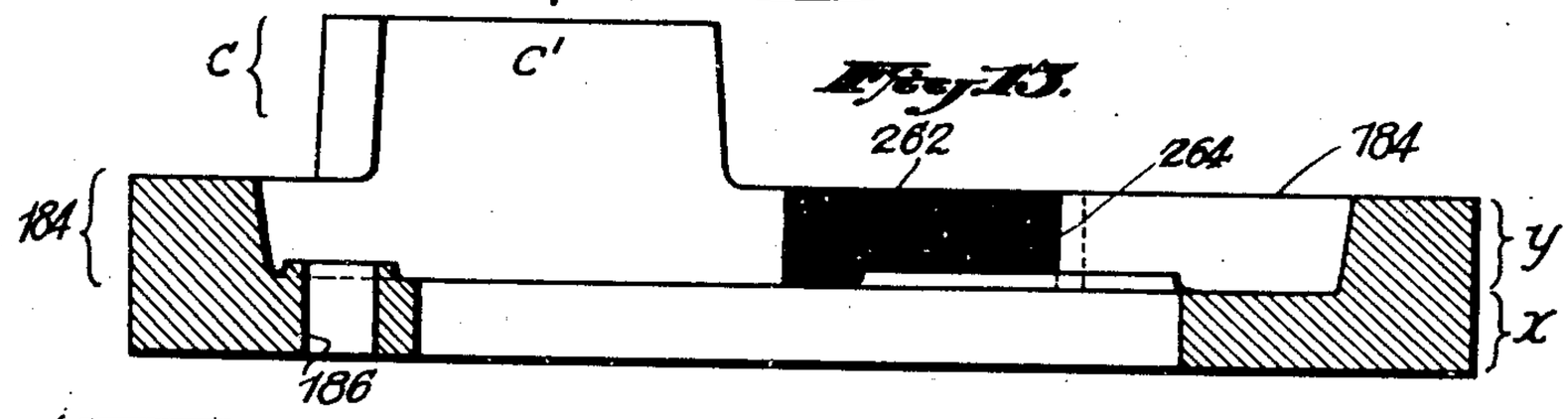


Fig. 14.

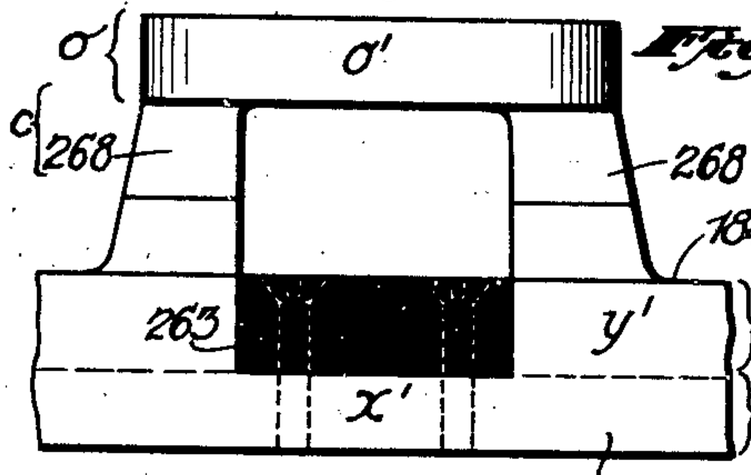


Fig. 15.

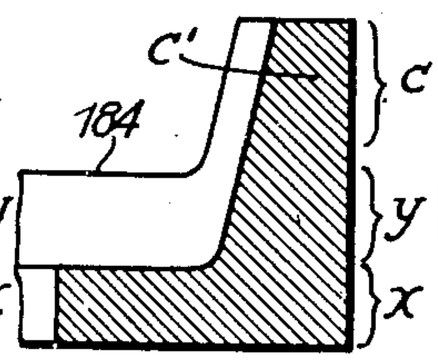
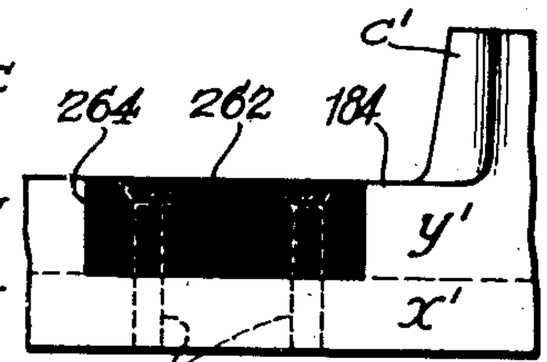


Fig. 16.



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POWER OPERATED SWITCH MECHANISM

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Fig. 10.

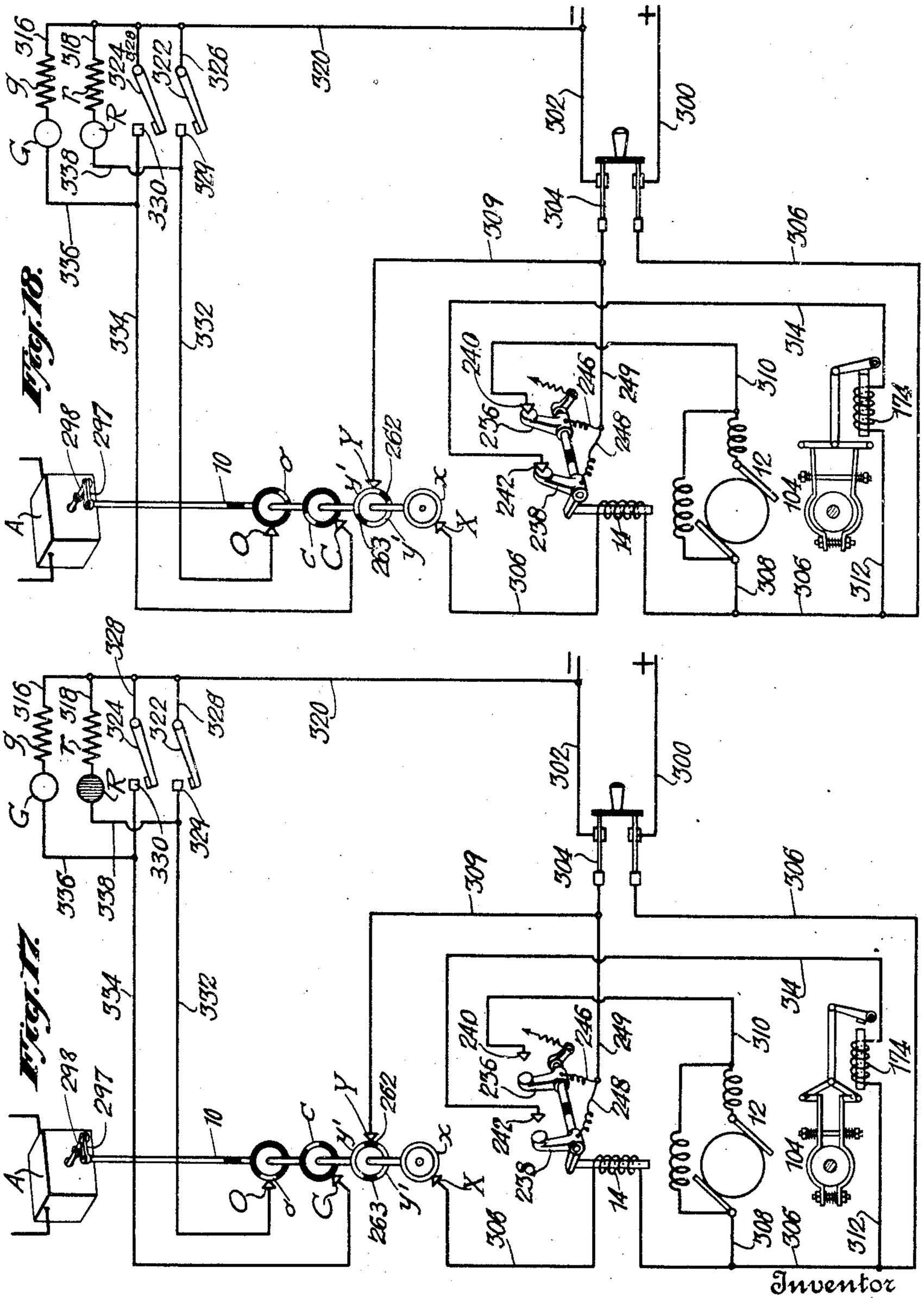

Fig. 11.

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POWER OPERATED SWITCH MECHANISM

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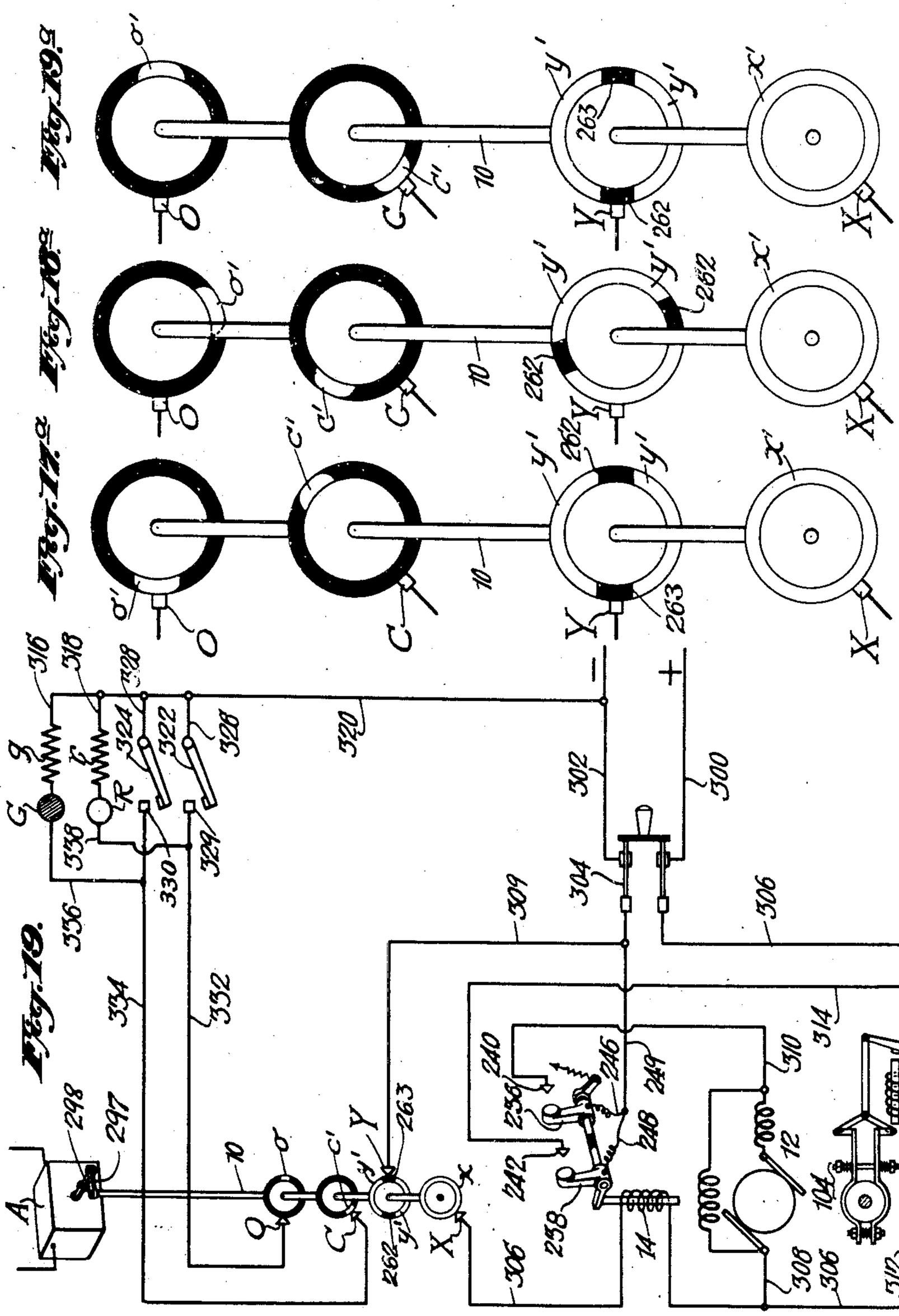

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UNITED STATES PATENT OFFICE

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POWER OPERATED SWITCH MECHANISM

Application filed July 25, 1928. Serial No. 295,338.

The invention will be fully apparent from the following detailed description of the construction and operation of the mechanism when read in connection with the accompanying drawings and the points of novelty will be defined with particularity in the appended claims. In the drawings—

Fig. 1 is a horizontal section illustrating a practical embodiment of the invention;

Fig. 2 is a transverse vertical section on line 2—2 of Fig. 1;

Fig. 3 is a similar vertical section on line 3—3 of Fig. 1;

Fig. 4 is a section at right angles to Figs. 2 and 3, the section being taken through the casing on line 4—4 of Fig. 1 and illustrating the operating mechanism mostly in elevation;

Fig. 5 is a transverse vertical section on line 5—5 of Fig. 1 illustrating, chiefly, the control relay;

Fig. 6 is a detailed section on an enlarged scale illustrating an improved form of magnetic brake;

Fig. 7 is an enlarged detail corresponding to parts shown in Fig. 2, the view being taken on the same section line of Fig. 2;

Fig. 8 is an enlarged detail section of parts shown in Fig. 3, the view being taken on the same section line as Fig. 3;

Fig. 9 is a detail section illustrating the construction of the control relay, the view being taken approximately on line 9—9 of Fig. 5;

Fig. 10 is a detail section on line 10—10 of Fig. 5;

Fig. 11 is a detail in plan view of a drum controller, the view being taken on line 11—11 of Fig. 7;

Fig. 12 is a detail view of one pair of the contact members which coact with the controller of Fig. 11;

Fig. 13 is a section on line 13—13 of Fig. 11;

Fig. 14 is a side view in the direction of arrow 14 of Fig. 11;

Fig. 15 is a section on line 15—15 of Fig. 11;

Fig. 16 is a side view in the direction of arrow 16 of Fig. 11;

Figs. 17, 18 and 19 are circuit diagrams illustrating the operation of the machine;

Figs. 17ª, 18ª and 19ª are diagrams illustrating different positions of the contacts showing the cycle of operation of the drum controller.

Referring to the drawings, the mechanism illustrated is adapted to open and close a main high voltage switch shown diagrammatically at A, this switch being of known construction and forming no part of the present invention. The switch A is so coordinated with my motor driven switch mechanism that when the vertical operating shaft 10 of my improved mechanism makes a half revolution, the main switch A will be closed. When the shaft 10 makes another half revolution, the main switch A will be opened.

My improved motor drive mechanism for the switch operating shaft 10 includes a motor 12 and certain push button control mechanism hereinafter more fully described which is so arranged that when one push button is actuated the drive motor 12 starts to rotate and continues its motion until the shaft 10 has made a half revolution at which time the braking action is exerted on the power transmission mechanism so as to stop the mechanism promptly so as to avoid overrunning of the motor or throwing the mechanism out of time. Another push button is provided which when actuated similarly controls the operation of the motor so that it will drive the vertical shaft 10 for another half revolution. One half turn of the shaft will open the main switch and another such half turn will close it, or vice versa depending upon which control button is actuated.

The remote control for the motor 12 works in conjunction with a relay 14 which is coordinated with the remote control push button system in a manner which will be later described in connection with the circuit diagrams and the operation of the mechanism as a whole.

My improved motor driven switch actuating mechanism is in the form of a self-contained unit parts of which are mounted on a base 16 enclosed by substantially dust-tight and water-proof casing 18 which is secured to upright angles 20 fastened to the corners

of the rectangular base 16. One end plate 22 is removably secured to the uprights 20 by means of keys 24 which engage slots formed in studs 26 secured to the uprights 20.

Shaft 28 of the motor 12 is connected by means of a suitable flexible coupling 30 to a worm shaft 32 mounted in adjustable ball bearings 34, 36 carried by uprights 38 of a bracket 40 which is bolted to the base 16. The shaft 32 has a worm 42 secured thereto by a tapered pin 44. The worm 42 meshes with and drives a worm wheel 46 which is loosely mounted on an intermediate shaft 48. The worm 46 is formed in two parts including the outer toothed portion and an inner hub portion 50 having a flange 52 which is secured to the web 47 of the worm by means of bolts 54. The hub 50 is journalled on a ball bearing member 56 carried by an upright 58 of a bracket 60 secured to a bridge piece 62 having downwardly extending legs which are bent outwardly at their ends and secured by bolts 64 to the base 16. The bracket 60 also carries an upright 66 which carries a ball bearing member 68 which supports the outer end of the intermediate shaft 48. This shaft has keyed thereto a worm 70 which meshes with worm wheel 72 which is bolted to a hub 74 which in turn is secured to the vertical shaft 10 as shown in detail in Fig. 7.

The intermediate shaft 48 (Fig. 8) carries a pin 76 which is normally held in engagement with the slot 78 formed in the end of hub 50 by means of a spring 80 which surrounds the reduced end 82 of shaft 48, one end of the spring engaging the end wall 84 of a casing 86 secured at 88 onto the threaded end of hub 50. The left end of spring 80 presses on a washer 90 engaging a shoulder 92 of the shaft 48, thus tending to hold the pin 76 normally in engagement with the slotted end of the hub 50.

The left end of the intermediate shaft 48 carries the pin 94 adapted to be engaged by the slotted and socketed end 96 of a hand crank 98. This hand crank is shown in working position but is normally disconnected from the mechanism and is operated only in emergency cases in the event that any part of the mechanism becomes disabled or in cases of emergency when the current for the motor 12 is interrupted due to failure of generating apparatus or damage to the current supply mains. In such emergencies, the socketed portion 96 of the hand crank is engaged with the pin 94 and the intermediate shaft 48 is pushed to the right in Figs. 8 and 3 against the action of the spring 80 so as to disengage pin 76 from the slot 78 in the end of the worm hub 50. During such a manual operation, the key 100 secured to the intermediate shaft 48 will slide longitudinally in the key seat 102. With the pin 76 disengaged from the slot 78 in the worm hub 50, it is clear that an operator can turn the shaft 48 and thus drive the vertical switch operating shaft manually through worm gear 70 and worm wheel 72.

This is desirable because of the difficulty of turning the mechanism by hand if the worm wheel 46 and motor worm 42 were included in the gear train. It is also desirable to break the connection between shaft 48 and the worm wheel 46 and worm 42 because of the drag which would otherwise be occasioned by the brake 104.

The brake indicated generally at 104 and shown in detail in Fig. 6 includes a drum 106 secured to the motor shaft 28 and a pair of brake shoes 108 and 110 lined with suitable friction fabric 112. The brake shoes 108 and 110 as shown in Fig. 6 include perforated extensions 114 and 116, respectively, which loosely engage an upright threaded rod 118 which is threaded into and secured to the base 16. The upper end of the rod 118 is threaded for engagement with nuts 120 and 122 which provide adjustable fulcrums for the brake shoe extensions 114 and 116, respectively. These extensions are bent so as to form fulcrum knuckles 124 and 126 for engagement, respectively, with the nuts 120 and 122. A spring 128 surrounds the rod 118 and engages washers 130 which in turn engage the extensions 114 and 116, thus tending to hold the knuckles 124 and 126 in fulcruming engagement with the nuts 120 and 122.

The left portions of the brake shoes 108 and 110 are formed with extensions 132 and 134. These extensions are perforated and a rod 136 secured to the base 16 projects through perforations in said extensions, said rod carrying springs 138 and 140 seated on nuts 142 and 144 adjustably threaded on the rod 136. The springs 138 and 140 tend normally to hold break shoes 108 and 110 in braking engagement with the brake drum 106 carried by the motor shaft.

Near the outer extremity of the extensions 132 and 134, oppositely extending studs 146 and 148 are provided for the accommodation of toggle bearing blocks 150 and 152 which are slidably mounted thereon. These blocks carry trunnion projections 154 and 156 for engagement with toggle links 158 and 160. The toggle links engage a pin 162 carried by a brake push rod 164 which is connected at 166 with an armature member 168 pivoted at 170 to a bracket 172 carrying a brake magnet 174. A spring 176 is provided having one end connected to the brake push rod 164 and its other end secured to an adjustable anchor bolt 178 carried by a fixed bracket 180. The brake arrangement is such that the springs 138 and 140 tend to rock the shoes 108 and 110 about the fulcrum knuckles 124 and 126 and no braking action is exerted by the spring 176, the function of this spring being to break the toggle upon deenergization

of the brake magnet 174. With the brake arrangement shown and described, it is apparent that when the magnet 174 is energized, the armature 168 will be swung to the right in Fig. 6, thus tending to spread the toggle links and release the brake shoes. The adjustable fulcrum nuts and brake shoe knuckles are of particular importance in mechanism of the character described for it permits of making an accurate brake setting and also provides for adjustment to compensate for wear. The adjustable nuts 142 and 144 permit ready adjustment of the braking action and provide a construction which is readily accessible. The floating toggle and push rod arrangement avoids disadvantages found in prior brake constructions in which operating members working in fixed bearings which are apt to bind and interfere with proper braking action.

Referring now to the mechanism associated with the vertical shaft 10 driven by worm 70 on the intermediate shaft 48 and worm wheel 72 carried by the vertical shaft 10, worm wheel 72 has structurally secured thereto and electrically insulated therefrom by a body of mica or similar dielectric material 182, a controller drum 184. This drum 184 is arranged to be adjusted angularly with respect to the gear 72 for the purpose of making an initial setting of the parts. To permit of such adjustment, the drum is formed with arcuate slots 186 through which project clamp bolts 188 secured to the web of the worm gear 72, said bolts being provided with clamp nuts 190 by means of which the drum 184 is fixedly secured to the worm gear 72. The securing bolts 188 are insulated from the controller drum 144 by fibre bushings 192.

The vertical shaft 10 as clearly shown in detail in Fig. 7 is supported at its lower extremity by a vertically adjustable ball thrust bearing 194 secured to the lower arm 196 of a bracket 198 which is also formed with an upper arm 200 having an adjustably mounted ball bearing member 202 for coaction with a ball bearing collar 204 pinned or otherwise secured to the shaft 10. A plate 206 located outside of the casing is secured thereto by means of bolts 207 engaging the arm 200 of the bracket 198 and a gasket or packing strip 208 is provided so as to make a practically dust and water-tight connection. The shaft 10 is also provided with a gland nut 210 for compressing packing 212 about the shaft so as to make a tight running fit.

The controller drum 184 is arranged to coact with four contact members which are substantial duplicates of one another but which control the circuits at different times as will hereinafter be described in connection with the description of operation. The drum indicated as a whole by numeral 184 may be considered as one-piece, electrically speaking, but provided with four zones x, y, c and o one above the other as diagrammatically indicated in Figs. 17ª, 18ª and 19ª and shown in Figs. 13, 14 and 15, each zone co-operating with one of the contact members to be described. The four contact members are of identical construction and are separately identified as X (feeder), Y (retaining), C (connected to "closing button") and O (connected to "opening button"). The contact X is always in electrical connection with the portion x' of lowest zone x of the controller drum 184. The retaining contact Y coacts with portions y' of the zone y of the controller drum above that engaged by the contact X. The contact C coacts with the intermediate portion c' of the controller drum zone c just above that engaged by the contact Y. Likewise, contact O coacts with the portion o' of the controller drum zone o.

The drum portion X′ of zone x is a continuous circular portion, therefore, the contact X is always in electrical connection with the drum. The zone y of the controller drum is interrupted and electrical connection is only made when the upwardly projecting portions y' engage the brush Y. Similarly, the contacts O and C are included in circuit only when the projecting portions o' and c' engage therewith. It is clear from the drawings that the several portions y', c' and o' are all electrically connected with the portion x' of the controller drum.

The contact X serves as a feeder. The contact Y serves to retain the circuit through the mechanism for a sufficient length of time to complete one cycle of operation. This contact maintains a closed circuit during the period of time that the main switch operating shaft 10 is moving and said contact opens the circuit at the end of each cycle of operation. The contact O is in closed circuit engagement with the controller portion o' only for a sufficient length of time to start the mechanism in operation to cause an opening movement of the main switch operating shaft 10. Likewise, the contact C is in closed circuit position with the controller portion c' only for a sufficient interval of time to start closing movement of the main switch operating shaft 10.

The contact X is electrically connected with the winding of a relay 14. This relay is supported by a yoke 214 secured to a panel 216 which is carried by bars 218 hinged at 220 (Figs. 1 and 5) to one of the corner uprights 20 carried by the base of the machine. This arrangement permits the relay and related parts mounted on the panel 216 to be swung outward for inspection of the wiring or renewal of fuses, etc., when necessary.

The relay 14 is in the form of a solenoid having a movable iron plunger 222 carrying a brass washer 224 and brass rod 226, the rod freely sliding in a steel core 228 secured to the relay yoke.

Pivotally mounted above the yoke 214 in brackets 230 is a shaft 232, the central portion of which between the brackets is of square cross-section. This shaft carries a laterally projecting finger 234 which coacts with the plunger rod 226 so that when the relay coil is energized, the shaft and contact fingers 236 and 238 carried thereby are moved to the position of Figs. 5 and 9 where they electrically connect with terminal bolts 240 and 242 which are adapted to be connected respectively with the motor 12 and the winding of the brake magnet 174. The contact fingers 236 and 238 are insulated from one another and from the shaft 232 by mica or fibre sleeves 244 and these fingers are connected by flexible lead 246 and 248 to terminal posts 250 and 252 carried by the panel 216. The terminals 250 and 252 are connected through suitable fuses 254 and 256 carried by the panel 216 to circuit wires to be presently described in connection with Figs. 17 to 19 inclusive. The base of the machine carries a terminal block 258 of stock form having many contacts 260 for facilitating the identification of the electrical connections leading to the motor, relay, brake, etc. The actual conductors connecting these parts have been omitted from the drawings in the interest of clearness and further because the operation will be more readily apparent from the description in connection with the circuit diagrams.

The construction of the controller drum is illustrated in detail in Figs. 7 and 11 to 16 inclusive. As illustrated in Figs. 11, 13, 14 and 15, it is apparent that the portion of the lowest zone of the drum indicated at x' extends in an unbroken line completely around the periphery. The zone y next above is, electrically speaking, divided into two segment portions y'—y' by means of fibre or other dielectric inserts 262 and 263 which are seated in recesses 264 and secured in place by screws 266.

The contact portion c' of zone c is in the form of an upstanding arcuate lug, the height of which is insufficient to reach the uppermost contact brush O. This brush O coacts with an arcuate portion o' of zone o carried by lugs 268 which straddle the fibre insert 263.

The brush contacts X, Y, C and O are substantial duplicates, therefore, a detailed description of the construction of one will suffice for all. The contacts O and Y are carried by the same bracket 270 and the contacts C and X are carried by the same bracket 272. These brackets are secured by suitable bolts as shown to the upper arm 200 of the bracket 198. These contacts, of course, are electrically insulated from one another and are positioned at elevations to coact, respectively, with the portions o', y', c' and x' of the controller drum. The brackets 270 and 272 as shown in detail in Fig. 12 are each provided with a downwardly extending member 274 surrounded by a layer of fibre or other insulation 276 and bolts 278 and 280 pass through suitable holes formed in plates 282 and 284 which jointly serve to guide the contact members. The plate 282 is apertured at 286 to form a guide for the contact member.

Each contact member is provided with a shank 288 which passes through a guide hole 290 formed in the plate 284. A spring 292 surrounds the shank and tends to press the contact member toward the controller drum. A stop pin 294 is provided in the shank 288 to limit the movement of the contact member. Each shank 288 also carries a binding screw 296 by means of which the lead wire is electrically connected with the contact member.

The operation of the machine will be clearly understood from the diagrammatic Figures 17 to 19 inclusive. As before stated, the machine illustrated is adapted to actuate the main switch of known construction which is indicated diagrammatically at A. When the vertical shaft 10 of the machine is given a half revolution, a crank 297 connected to link 298 will move the mechanism of the main switch A to the open circuit position and simultaneously a green signal light will be illuminated. Upon actuation of a suitable control button, the machine may be set in motion so as to move the shaft 10 for another half revolution whereupon through crank 297 and link 298 the main switch will be moved to closed circuit position and the green light will be cut out of circuit and a red signal light will be cut in circuit.

Referring to the circuit diagrams, Fig. 17 illustrates diagrammatically the circuit connections when the mechanism of the foregoing description has stopped in the position in which the main switch A actuated by the shaft 10 is in closed position. During this interval, a red signal light R is illuminated.

Fig. 18 shows the circuit connections during the part of the cycle while the mechanism is in motion to effect either the closing or opening movement of the main switch A. During this period neither signal light is illuminated.

Fig. 19 illustrates the circuit connections when the mechanism has stopped after the shaft 10 has moved main switch A to open position. At this time, a green signal light G will be illuminated. In short, Fig. 17 illustrates the closed position; Fig. 18, the running position and Fig. 19, the open position of the switch operating mechanism and the main switch.

Current for operating machine is supplied from the positive and negative D—C busses 300 and 302, respectively, which connect through a knife switch 304 with wires 306 and 309, respectively. The wire 309 connects with the contact brush Y. Wire 306 is in

effect an extension of the positive bus 300 and the relay coil 14 is connected in series therewith. This wire 306 connects to the contact brush X.

The motor 12 is connected by wire 308 with the positive feed wire 306 and wire 310 leads from the motor to the relay contact 240. The brake magnet 174 is connected by wire 312 to the positive feed wire 306 and by wire 314 to the relay contact 242. As thus arranged, it is clear that for any part of the cycle of the machine during which the contact Y (which is connected by wire 309 to the negative bus 302) engages either one of the conducting segments y'—y', a circuit is established across the positive and negative busses 300 and 302 through the motor 12, relay coil 14 and brake coil 174. Energization of the relay coil 14 causes contact fingers 236 and 238 to close the motor and brake circuits through contacts 240 and 242 across the negative and positive conductors 309 and 306.

The green signal light G and red signal light R are connected through respective resistances g and r by means of wires 316 and 318 with a branch feed wire 320 leading to the negative bus 302. Push button switches 322 and 324 are connected by wires 326 and 328 with the feed wire 320. These push button switches coact with contacts 329 and 330, respectively. The contact 329 connects by means of wire 332 with the contact O. Similarly, contact 330 connects by means of wire 334 with the contact C. The green light G connects by wire 336 with the wire 334 and the red light R connects by wire 338 with the wire 332.

Assuming that the push button 322 has been operated so as to open the main switch, a circuit will be established from the negative feed wire 320 through contact 329 to wire 332, thus short-circuiting the red light R and the resistance r. Current will then flow through contact O, controller section o and contact X through the relay coil 14, thus energizing it and closing the circuit through contacts 240 and 242, leads 246 and 248 and wire 249 to negative conductor 302.

Closing of the circuit at contacts 240 and 242 will close the power circuit through the motor 12 and will energize the brake magnet 174 so as to release the brake. During this operation while the machine is in motion, the power circuit will be closed as indicated in Fig. 18. Reference to this figure will show that circuit is sustained by the contact Y in running position, the same being in engagement with one or the other of the live portions y' of the controller.

During the running of the mechanism, neither the green light nor red light will show because the circuit is interrupted at the points C and O at such time. After the vertical shaft 10 of the machine has made one-half revolution, the contact Y will engage the fibre insert 262 and because its circuit will be broken, the motor will stop and the main switch A will be in closed position. The brake magnet will be de-energized and the springs will exert a braking action so as to prevent overtravelling. This condition is illustrated in the circuit diagram of Fig. 17 wherein it will be seen that when the controller comes to rest, the contact O will establish a circuit by wire 332, wires 338 and 318 through the red signal light R to the negative feed wires 320 and 302. The positive feed will be through contact X, wire 306, knife switch 304 to the positive bus 300.

From the foregoing description it is clear that the mechanism includes transmission elements arranged to be driven by an electric motor whose circuit is controlled by a relay switch, and the supply of current to the relay switch is under the control of a drum-like member driven by the transmission elements of the device. The remote control push button arrangement is combined with the mechanism in such a way that one button is capable of starting the mechanism in operation to open the main switch A and another button is arranged to start the mechanism in operation to close said main switch.

The circuit arrangement is such that when the main switch is in open position a green signal light is included in the circuit and when the main switch is in closed position, a red light is included in the circuit. When either control push button is actuated, a corresponding light and a resistance in series therewith is momentarily short-circuited. Such short-circuiting of the light and resistance permits an increased current to flow through the relay switch winding. This increased current through the relay winding causes it to close a circuit to set the motor mechanism in motion and also to release the brake which is operatively associated with the motor. As soon as the motor forming part of my switch mechanism is started, the push button system is automatically cut out of circuit and is rendered inoperative to effect motor operation. After the motor mechanism has completed a given cycle of operation, a braking action is exerted on the transmission mechanism and the push button mechanism is automatically restored to an operative condition so that is can control either an opening or closing movement of the main switch.

Various modifications may be made by those skilled in the art without departing from the invention as defined in the following claims.

What I claim is:—

1. An apparatus of the class described comprising a main switch, a motor and power transmission mechanism including worm gearing operatively connected therewith, a self-contained controller unit driven through

said worm gearing by said motor, and means coacting with said controller for maintaining a circuit through the motor for a sufficient time interval to effect the movement of the main switch to its full open or its full closed position, and means for adjusting the controller unit as a whole relatively to said worm gearing and transmission mechanism whereby an accurate setting is secured so that the motor circuit will be controlled with precision to stop the main switch in exactly its full open or full closed position.

2. An apparatus of the class described comprising a main switch, a motor and power actuated mechanism for moving said switch including two sets of gearing one of which is directly connected to said motor and the other of which is directly connected with said main switch and a clutch for breaking the connection between said two sets of gearing adapted to render the motor inoperative to move the switch and permit manual operation of one set of said gearing.

3. In an apparatus of the class described, a rotary controller drum having interrupted portions to divide the same into different zones, slidably mounted spring pressed contact members, and means for supporting them in position for coaction with the different zones of the controller comprising brackets carrying spaced plates perforated to form guides for said contact members the plates and brackets being of metal and separated by strips of insulating material.

4. In an apparatus of the class described, a rotary controller drum having interrupted portions to divide the same into different zones, spring pressed contact members, and means for supporting them in position for coaction with the different zones of the controller comprising brackets having depending portions extending substantially parallel to the axis of rotation of said drum, and plates clamped to and insulated from said portions and having guide apertures formed therein for slidably supporting said contacts.

5. An apparatus of the class described comprising a self-contained switch operating mechanism including a drive motor, transmission mechanism driven thereby, a brake normally tending to prevent motion of said transmission mechanism, electromagnetic means for releasing said brake and a controller and a relay jointly controlling the operation of said motor and said brake.

6. An apparatus of the class described comprising a self-contained switch operating mechanism including a drive motor, transmission mechanism driven thereby, a brake normally tending to prevent motion of said transmission mechanism, electro-magnetic means for releasing said brake and a controller and a relay jointly controlling the operation of said motor and said brake, said relay including a coil and contact fingers actuated thereby, and a pivotally mounted panel for said relay coil and fingers.

In witness whereof, I have hereunto signed my name.

HOWARD D. SALISBURY.