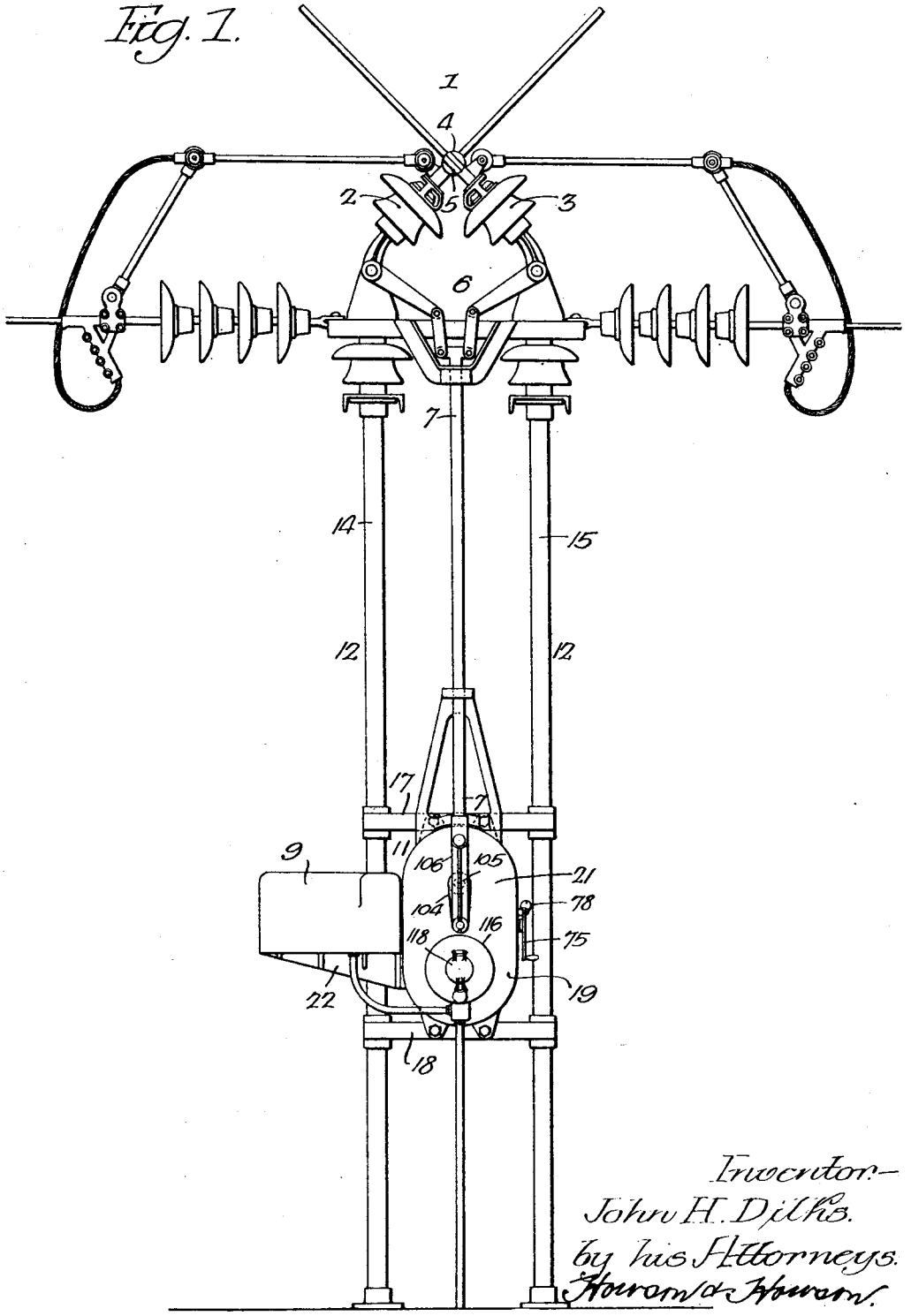
Sept. 18, 1928. 1,685,069

J. H. DILKS

SWITCH OPERATING MECHANISM

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Fig. 1.



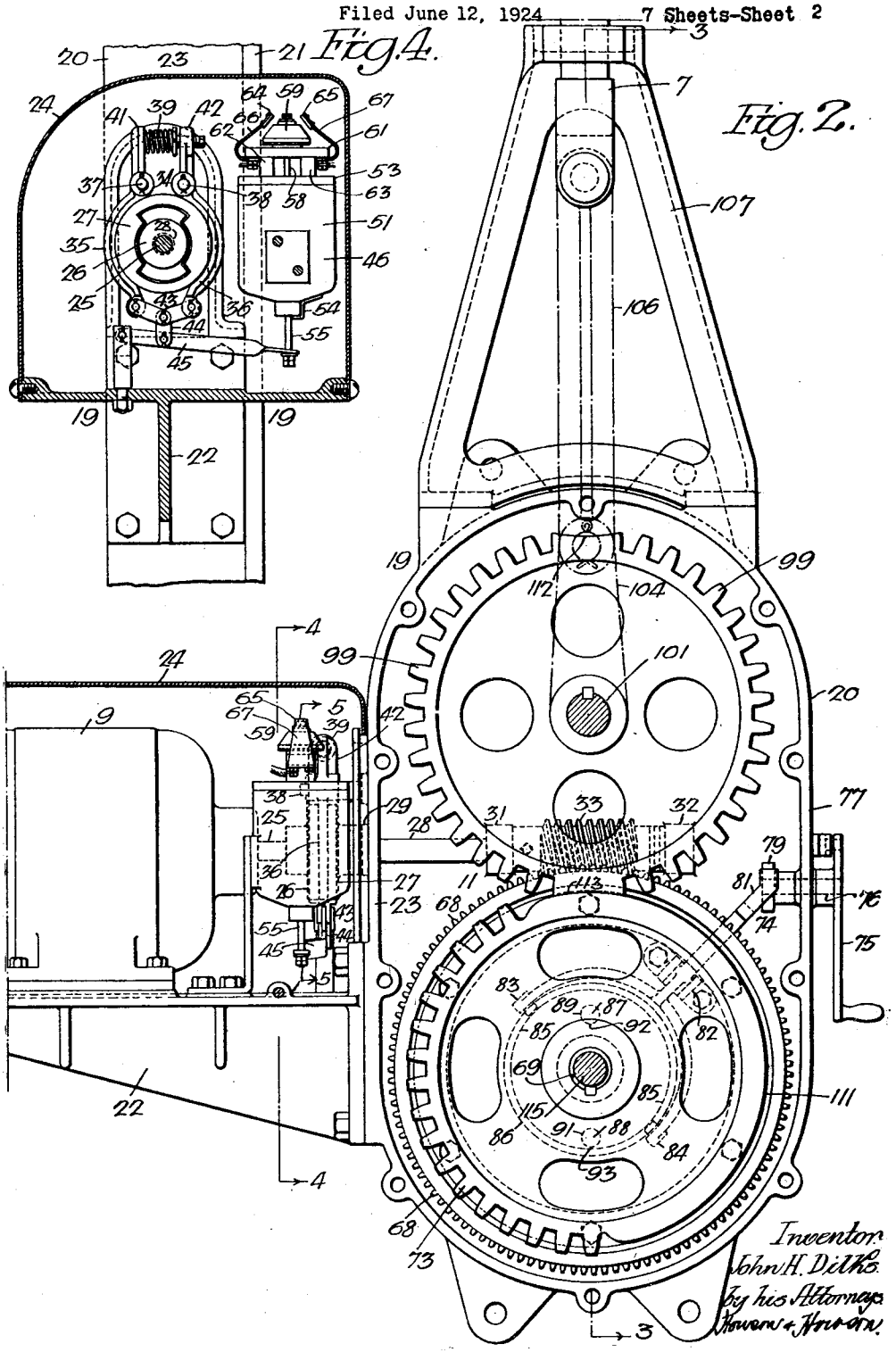
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SWITCH OPERATING MECHANISM

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SWITCH OPERATING MECHANISM

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Fig. 3.

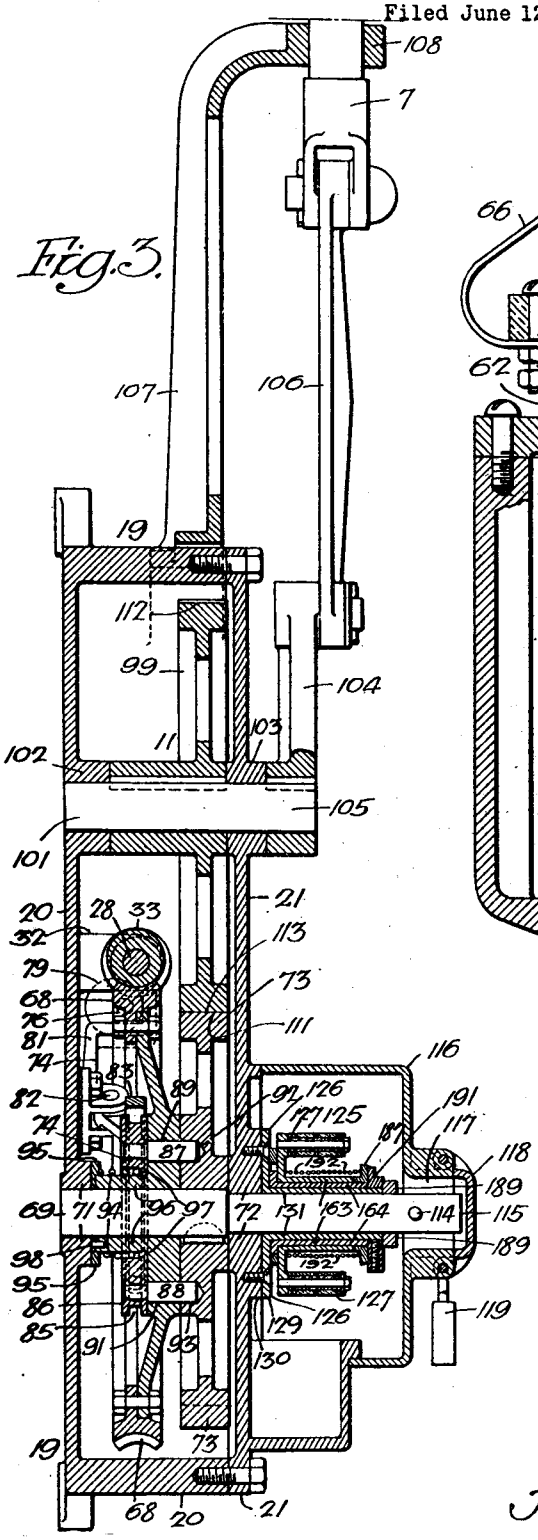
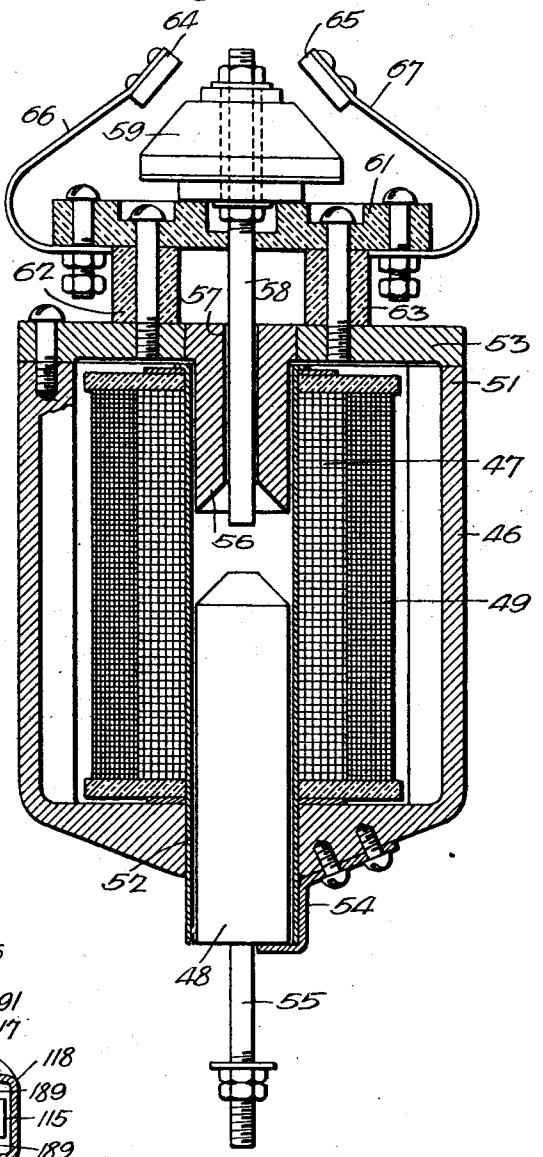


Fig. 5.



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SWITCH OPERATING MECHANISM

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Fig. 6.

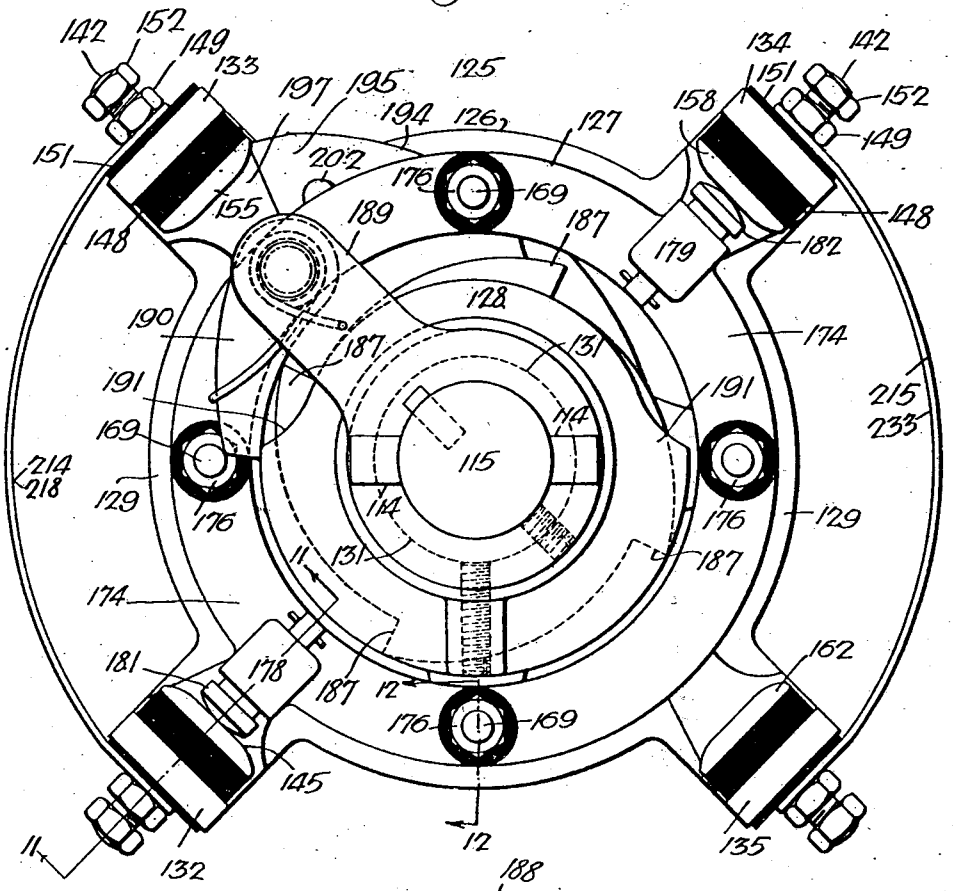
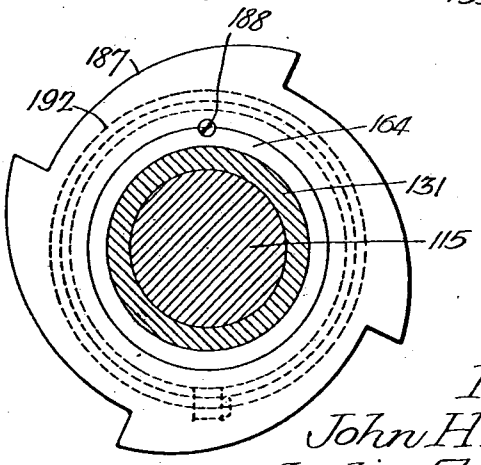


Fig. 10.



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SWITCH OPERATING MECHANISM

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Fig. 7.

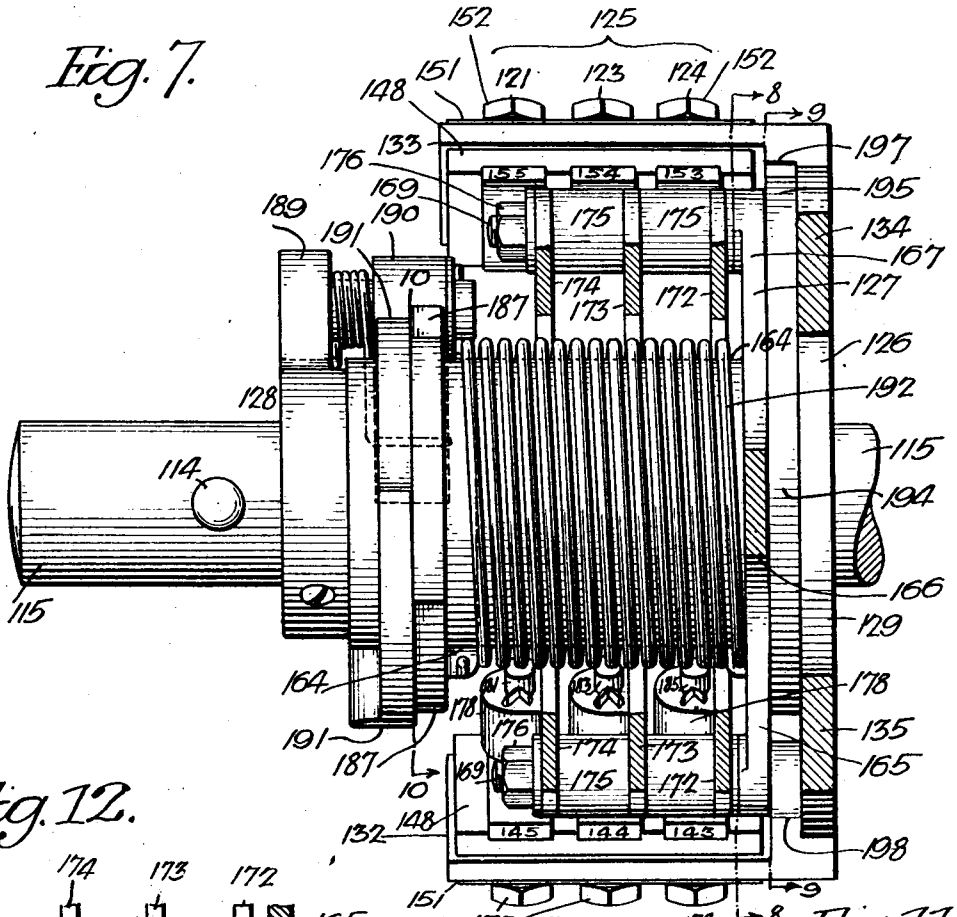


Fig. 12.

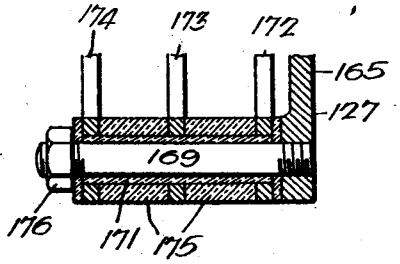
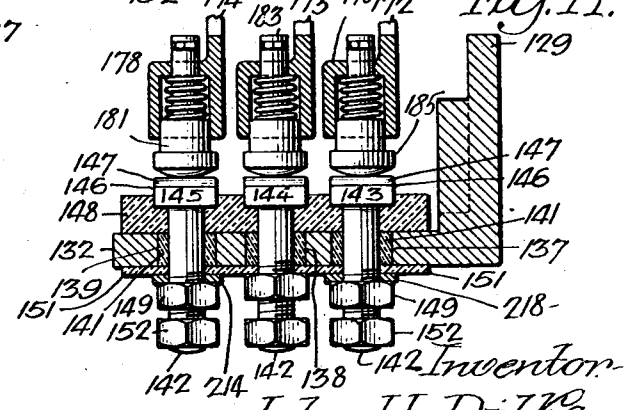


Fig. 11.



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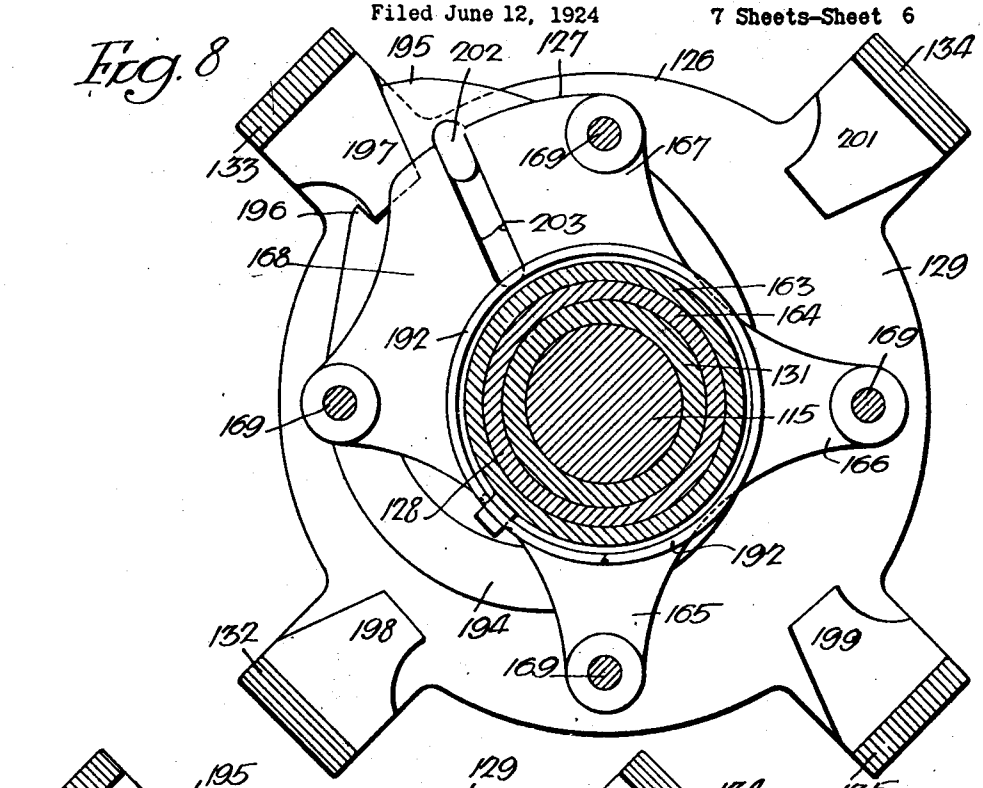
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SWITCH OPERATING MECHANISM

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Fig. 8



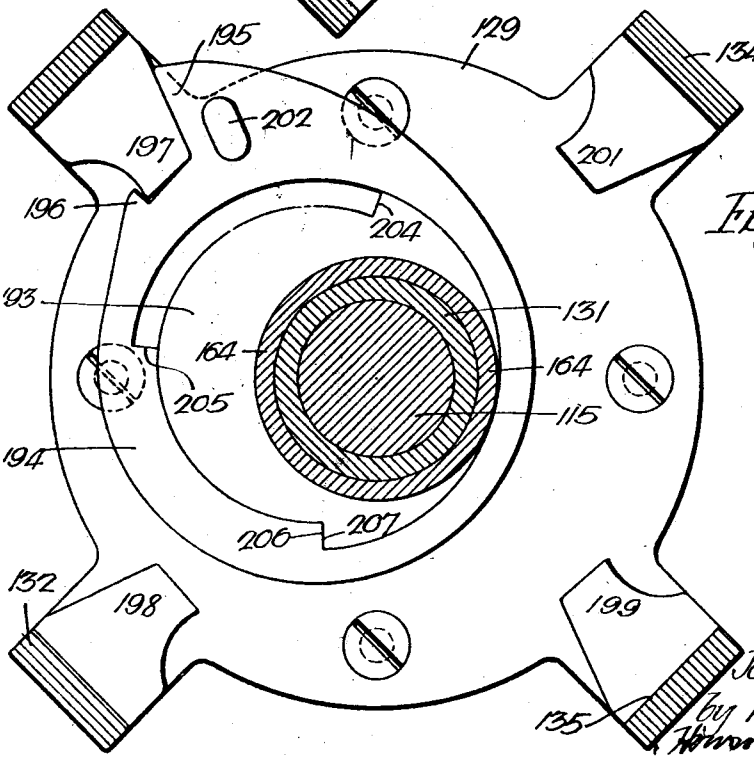


Fig. 9.

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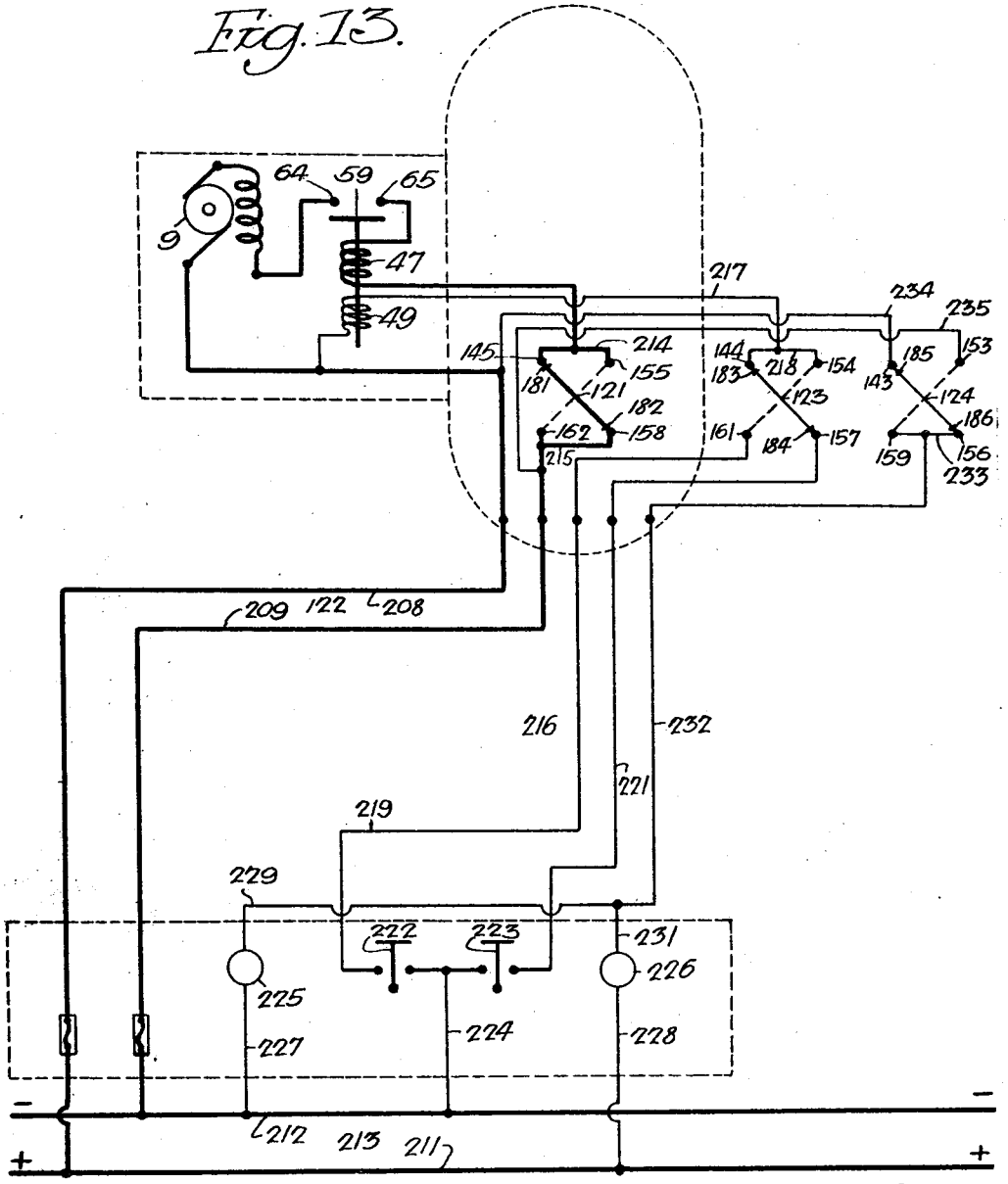
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SWITCH OPERATING MECHANISM

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Fig. 13.



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Patented Sept. 18, 1928. 1,685,669

UNITED STATES PATENT OFFICE.

JOHN H. DILKS, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO ELECTRIC POWER EQUIPMENT CORPORATION, OF PHILADELPHIA, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

SWITCH-OPERATING MECHANISM.

Application filed June 12, 1924. Serial No. 719,677.

My invention relates to switches for electrical circuits, having particular relation to means for controlling the operation thereof.

One object of my invention is to provide simple and efficient means, whereby apparatus of the class described may be operated at will from a remote point.

Another object of my invention is to provide electrical means for operating a high-voltage switch, said electrical means being automatically rendered ineffective when the switch has moved from one operative position to another, together with a system of remote control including means for indicating the position of the switch.

A further object of my invention is to provide a system of control for a driving motor, which causes the inoperation of said driving motor after a predetermined range of movement thereof and which substantially simultaneously causes the application of braking means to avoid overtravel of the driving motor.

A still further object of my invention is to provide an electrical system including a motor, an energizing circuit therefor, a relay for controlling said circuit, and a limit switch operable to open and to close said circuit after a predetermined range of motor movement to cause the operation of said relay.

A still further object of my invention is to provide a system of control which includes a plurality of control switches together with a switch for rendering certain of said control switches operative, depending upon the position of the high-tension switch to be operated.

A still further object of my invention is to provide an electrical system comprising a driving motor; an energizing circuit therefor; a relay for normally interrupting said circuit, the actuating winding of said relay being included in said circuit; a secondary actuating winding adapted to cause the relay to move into its circuit-closing position; a second energizing circuit including said secondary actuating winding; a plurality of switches included in said secondary circuit, one of said plurality of switches being adapted to render certain of the remaining switches effective or ineffective; a limit switch for opening and closing said first-mentioned energizing circuit when said motor has moved through a predetermined range; a plurality of indicating means; and a switch actuated in accordance with the movement of said limit switch for successively energizing said plurality of indicating means.

A still further object of my invention is to provide a switch construction, wherein the movable contacts are caused to snap from one position to another under action of energy which is stored while the switch is at rest.

A still further object of my invention is to provide a switch construction, wherein the movable switch contacts may be positively moved from one locked position to another, the switch construction being further characterized by certain other desirable features hereinafter set forth.

Other objects and applications of my invention, as well as details of construction and operation, whereby my invention may be practiced, will be apparent more fully hereinafter from the following description and claims, when taken in connection with the accompanying drawings, wherein,

Fig. 1 is a side elevational view of one form of embodiment of my invention;

Fig. 2 is a detail side elevational view, partially in section, of certain portions of the switch-actuating mechanism of Fig. 1;

Fig. 3 is a transverse sectional view taken on the line 3—3 of Fig. 2;

Fig. 4 is a view similar to Fig. 3 taken on the line 4—4 of Fig. 2;

Fig. 5 is a sectional view taken on the line 5—5 of Fig. 2;

Fig. 6 is an end elevational view of the switch mechanism shown in Fig. 3;

Fig. 7 is a side elevational view, partly in section, of the structure of Fig. 6;

Fig. 8 is a transverse sectional view taken on the line 8—8 of Fig. 7;

Figs. 9 and 10 are similar views taken respectively on the lines 9—9 and 10—10 of Fig. 7;

Fig. 11 is a detail longitudinal sectional view of the stationary and movable switch elements, the sectional plane being taken on the line 11—11 of Fig. 6;

Fig. 12 is a similar view showing the manner of mounting the contact supporting rings

on the switch arms, the sectional plane being taken on the line 12—12 of Fig. 6; and

Fig. 13 is a diagrammatic view of circuits and apparatus embodying my invention.

For purposes of illustration, I have shown a practical embodiment of my invention, as applied to the operation of a high-voltage switch 1 of the type disclosed in Patent No. 1,415,708, granted May 9, 1922, to R. Renke. In general, the switch therein disclosed comprises a pair of pivotally mounted insulators 2 and 3 (Fig. 1) carrying cooperating contact elements 4 and 5 movable in parallel planes into and out of engagement under the reciprocal movement of linkage 6, which terminates in a common vertically movable shaft 7, as set forth in the patent in question. The shaft 7 may be successively actuated to open and to close the switch 1 by means of a driving motor 9 (Fig. 2) through intermittently actuating mechanism 11, or directly by hand operation when a clutch lever 75 (Figs. 1 and 2) has been moved to disengage the driving motor 9 from the associated mechanism 11, all as will appear more full hereinafter.

The switch mechanism 1 may be mounted on a tower 12 (Fig. 1) comprising vertically extending members 14 and 15 which are secured in spaced relation by transversely extending members 17 and 18. The spaced members 17 and 18 provide a rigid support for a gear casing 19 having an integral base portion 20 and a removable cover portion 21 to provide a closed compartment for the intermittently actuating gearing 11. The motor 9 is mounted on a bracket 22, which is secured to a wall 23 of the gear casing 19, and it is provided with a protecting cover 24. A shaft 25 of the motor 9 carries a flanged hub portion 26 (Fig. 4) adapted to engage a correspondingly recessed brake disk 27 which is rigidly secured on one end of a worm shaft 28. Worm shaft 28 is journaled in a bearing 29 formed in the side wall 23 of the gear casing 19 and also in spaced bearings 31 and 32 extending from the base portion 20 of the gear casing,—a worm 33 being keyed on the portion of the worm shaft 28 intermediate the bearing 31 and 32.

In order to avoid overtravel of the motor 9, when the high-voltage switch 1 has been actuated to either of its positions, I provide a brake structure 34, of which the brake disk 27 is one element and a pair of brake bands 35 and 36 constitute the cooperating elements. The brake bands 35 and 36 have their upper ends pivotally mounted on pins 37 and 38, respectively, which are carried by the side wall 23 of the gear casing 19. The brake bands 35 and 36 may be normally actuated into resilient engagement with the brake disk 27 by means of an adjustable spring 39 extending between projections 41 and 42 of the brake bands 35 and 36, respectively. The lower ends of the brake discs 35 and 36 are interconnected by a toggle-joint 43 adapted to be actuated by a link 44, which is secured to a pivoted lever 45 movable in a vertical plane, whereby the brake bands 35 and 36 may be actuated out of engagement with the brake disk 34 against the force of the spring 39 when the motor 9 is to move freely.

The brake-releasing lever 45 may be actuated by means of a master relay 46 (Fig. 5) which comprises a cylindrically formed actuating winding 47 and a core member 48 movable axially thereof. A secondary actuating winding 49 encircles the actuating winding 47 and it is designed to actuate the movable core 48 when the actuating winding 47 is deenergized, as set forth hereinafter. The actuating winding 47 and 49 as well as the movable core member 48 are enclosed by a casing 51 of magnetic material, the latter having a perforation 52 in the base thereof for the movable core member 48. The top portion of the casing 51 may be closed by a removable cover 53. The core member 48 may be supported in its lower position on a projecting end portion of a member 54 which is detachably secured on the base of the casing 51. A rod 55 extends downwardly from the lower end of the core member 48 and it adjustably carries the free end of the brake releasing lever 45, whereby the latter may be moved in accordance with the vertical movement of the core member 48.

The coven member 53 of the casing 51 is provided with an axial projection 56 extending into the base of the magnetizing winding 47, said projection 56 being provided with an axial perforation 57 adapted to slidably receive a stem 58 carrying on its upper end a contact member 59. The contact member 59 and the stem 58 are insulatingly supported in their lower position by a base member 61 which is mounted on spacing members 62 and 63 secured to the top side of the cover member 53. A pair of stationary contact members 64 and 65 are mounted directly above the cooperating movable contact member 59 on spring members 66 and 67, respectively, which are secured to the insulating base member 61, whereby a vertical movement of the contact member 59 may cause the stationary contact members 64 and 65 to be electrically connected. The vertical movement of the contact member 59 may be effected by the movable core member 48, which engages the lower end of the stem 58 when either of the magnetizing windings 47 or 49 is energized. The effect, therefore, of energizing either of the magnetizing windings 47 or 49 is to cause a vertical movement of the core member 48, which results in the closing of the relay and the simultaneous release of the brake 34 permitting the motor 9 to revolve freely.

The worm 33 (Figs. 2 and 3) is actuated by

the driving motor 9 and meshes with a worm-wheel 68 which is revolubly mounted on a shaft 69 journaled in bearings 71 and 72 formed in the base and the cover portions 20 and 21 of the gear casing 19, respectively. The worm-wheel 68 is operatively associated with a gear wheel 73, which is keyed to the shaft 69, through hand-clutch mechanism 74, so that the high voltage switch 1 may be operated by hand without interference by the motor 9.

The hand-operated clutch mechanism 74 comprises a clutch handle 75 which is rigidly secured to a short shaft 76 journaled in a side 77 of the gear casing 19. The handle 75 may be locked in a desired position, as shown at 78 (Fig. 1). The inner end of the shaft 76 carries a cam 79 which engages one end of a clutch lever 81 pivoted at 82 to the base 20 of the gear casing 19. The other end of the pivoted clutch lever 81 terminates in a yoke portion having fingers 83 and 84 adapted to engage a slot 85 formed in an annular clutch disc 86.

The clutch disc 86 carries pins 87 and 88 which are adapted to removably engage complementary pairs of borings 89—91 and 92—93 formed in the worm-wheel 68 and the gear-wheel 73, respectively. When the clutch-releasing handle 75 is so moved as to cause the cam 79 to actuate the pivoted clutch lever 81, the pins 87 and 88 are actuated out of the borings 92 and 93 in the gear-wheel 73, so that the operative connection between the latter and the worm-wheel 68 is broken. The resulting lateral movement of the clutch disc 86 is resisted by a spring 94, the opposite ends of which engage a plate 95 carried by a projecting hub portion 96 of the worm-wheel 68 and a flange 97 extending inwardly from the inner surface of the clutch disc 86. Relative rotative movement between the plate 95 and the hub 96 may be avoided by means of a pin 98.

In order to insure that the worm-wheel 68 will make a complete turn before the pins 87 and 88 are actuated into engagement with the borings 92 and 93 of the gear-wheel 73, under the action of the spring 94, I space the same at different radial distances from the shaft 69. As may readily be seen, if the pins 87 and 88 were spaced equally from the shaft 69, an operative connection between the gear-wheel 73 and the motor 9 would be effected when the worm-wheel 68 had turned through one-half a revolution only. The gear-wheel 73, which is actuated by the worm-wheel 68 through the operative connection effected by the clutch pins 87 and 88, meshes with a gear-wheel 99, the latter being keyed on a crank-shaft 101 journaled in bearings 102 and 103 formed in the base and cover portions 20 and 21 of the gear casing 19, respectively. A crank 104 is keyed on an outer end portion 105 of the crank-shaft 101, and it is operatively associated by means of a link 106 with the lower end of the vertically movable operating shaft 7. A bracket 107 extending from the top side of the gear casing 19 serves to provide a bearing 108 for the lower end of the operating member 7.

Since it is desirable that the operating member 7 be intermittently actuated by the motor 9, the gear-wheel 73 and 99 are so designed that a complete rotation of the former causes a half rotation only of the latter. One method of accomplishing this desired result is shown in Fig. 2, wherein one-half of the periphery of the gear-wheel 73 is formed to present a smooth surface 111 having the diameter of the pitch circle of this gear-wheel. The co-acting gear-wheel 99 is provided with oppositely positioned smooth portions 112 and 113 which are similarly formed on the periphery thereof and adapted to engage successively the smooth portion 111 of the gear-wheel 68.

The smooth portions 111, 112 and 113 are so designed that the teeth of the gear-wheel 73 engage the teeth of the gear-wheel 99 for one-half a revolution only, the smooth surface 111 of the gear-wheel 73 engaging one or the other of the smooth portions 112 and 113 of the gear-wheel 99 for the remaining half of the revolution, whereby the gear wheel 73 may turn freely for one-half of a revolution. This is of particular importance inasmuch as it prevents the over-travel of the motor 9, from the instant of the application of the braking apparatus 34 to the final stopping of the motor 9, from causing the operation of the switch-actuating shaft 7. The crank 104 is so mounted on the crank-shaft 101 that when the gear-wheel 73 passes through its effective portion of a revolution, the crank 104 is in alignment with the switch operating rod 7 and the high-voltage switch 1 is in either its open or closed position.

The high-voltage switch 1 may be manually operated, subsequent to the actuation of the clutch-release handle 75 by an operating handle (not shown) which is adapted to engage spaced pins 114 mounted on the outer end of an extension 115 of the driving shaft 69. The extension 115 of the shaft 69 may be enclosed by a casing 116 constituting an integral projecting portion of the removable cover 21. Access may be had to the clutch pins 114 through the casing 116 by providing an opening 117 in the outer end thereof, which may be closed by a hinged cap 118 adapted to be locked, as at 119.

Since it is desirable that the driving motor 9 actuate the high-voltage switch 1 just long enough to cause the same to move from one operative position to another, it becomes necessary to render the motor 9 automatically inoperative upon the completion of such movement. To this end, I provide a novel form of

limit switch 121 (Fig. 13) which operates substantially instantaneously to open and to close a motor energizing circuit 122. The limit switch 121 as well as switches 123 and 124, which control remote control circuits to be described hereinafter, are embodied in a single switch structure 125 which is so mounted on the projecting portion 115 of the shaft 69 as to be enclosed by the casing 116.

As shown in Figs. 3 and 6 to 12, inclusive, the switch construction 125 comprises a stationary contact-carrying structure 126, a movable contact-carrying structure 127 and mechanism 128 adapted to cause the successive actuation of the movable structure 127. The stationary contact-carrying structure 126 comprises a base portion 129, which is adapted to be secured to an outer face portion 130 (Fig. 3) of the gear cover 21, and a tubular portion 131 which extends from the center of the base portion 129 axially of the shaft extension 115 and loosely engages the same. A plurality of contact-supporting arms 132, 133, 134 and 135 extend from the outer edge of the base portion 129 axially of the tubular portion 131 and they are spaced equiangularly about the same as a center.

The contact-supporting arm 132 (Fig. 11) may be provided with spaced perforations 137, 138 and 139, which are adapted to receive insulating bushings 141, the latter providing insulating mountings for the stem portions 142 of stationary contact elements 143, 144 and 145. The stem portion 142 of each stationary contact element terminates at one end in a head portion 146 having a beveled contact-engaging face 147. An insulating block 148 is so formed as to provide an insulating mounting for the head portion 146 of the several stationary contact elements, whereby the same may be insulatingly supported in position. The other end of the stem portions 142 of the stationary contact elements extends through and beyond the arm 132, each end portion being threaded to receive clamping nuts 149. The several nuts 149 are insulatingly spaced from the supporting arms 132 by means of a member 151. A second nut 152 may be mounted on the threaded end of each stationary contact element, whereby an electric conductor may be secured thereto.

Similarly, the arms 133, 134 and 135 are respectively provided with stationary contact elements 153—154—155, 156—157—158, and 159—161—162, all as shown more particularly in Fig. 13 to be described more fully hereinafter. Since the stationary-contact elements 145—155—158—162 lie in a common plane transverse to the axis of the actuating shaft 115, they are adapted to constitute the stationary-contact elements of the motor limit-switch 121. Similarly, the contact elements 144—154—157—161, and 143—153—156—159 also lie in common planes, respectively, which are transverse to the axis of the actuating shaft 115, and are thereby adapted to constitute the stationary elements of the switches 123 and 124.

The movable switch apparatus 127 comprises a tubular member 163 which loosely engages a second tubular member 164, the latter being loosely mounted on the tubular projecting portion 131 of the stationary switch structure 126. The tubular member 163 is provided with laterally extending flange portions 165, 166, 167 and 168 (Fig. 8). The outer end of each flange is threaded to receive one end of a threaded rod 169 which extends longitudinally of the actuating shaft 115. Each rod is provided with an insulating bushing 171, whereby a plurality of rings 172, 173 and 174 may be insulatingly supported thereon, as shown in Fig. 12. The several rings are secured in spaced relation by tubular insulating elements 175 and the whole is rigidly clamped in position by means of nuts 176 mounted on the outer threaded end portion of the several supporting rods 169. The ring 174 is formed with a pair of integral casings 178 and 179, whereby contact elements 181 and 182, respectively, may be resiliently and removably supported therein. The elements 181 and 182 constitute the movable contact elements of the limit switch 121. Similarly, the rings 172 and 173 are provided with pairs of resiliently mounted contact elements 183—184 and 185—186 constituting the movable contact elements of the switches 123 and 124, respectively.

The mechanism 128 which intermittently operates on the movable switch structure 127 to cause it to move from one contact-engaging position to another under the action of stored energy, comprises a ratchet-wheel 187 which is rigidly mounted on the outer end of the tubular member 164, as by a locking screw at 188 (Fig. 10). The end of the actuating shaft 115 adjacent thereto rigidly carries an arm 189 (Fig. 6) on the outer end of which is resiliently mounted a pawl 190 adapted to engage the ratchet-wheel 187 and to move the same as well as the tubular sleeve 164. A cam 191, which is mounted on the outer end of the tubular projection 131 carried by the stationary switch structure, 126, serves to disengage the pawl 190 from the ratchet-wheel 187 when the extension shaft 115 has moved through a predetermined angle. The relative rotation obtaining between the ratchet-wheel 187 and the movable switch structure 127 may be utilized to store energy in a spring 192 (Fig. 7) which interconnects the two, whereby the movable switch structure 127 may be positively actuated under the force of the spring 192 independently of the actuating shaft 115.

In order to release the energy, which is stored in the spring 192 during the period of

actuation thereof by the ratchet-wheel 187 and thereby permit a turning movement of the movable switch apparatus 127, I provide a special form of latch construction comprising an eccentric 193 which is mounted on the inner end of the tubular element 164 carrying the ratchet-wheel 187. A cooperating eccentric-strap 194 (Fig. 9) is provided with a slotted portion forming shoulders 195 and 196, the latter being of a shorter radial length than the other. The base portion 129 of the stationary switch structure 126 is provided with a plurality of equiangularly positioned retaining flanges 197, 198, 199 and 201 adapted to engage successively the locking shoulders 195 and 196 of the eccentric-strap 194 as the latter is moved under the force of the spring 192. The movable switch structure 127 is operatively associated with the eccentric-strap 194 by means of a lug 202 which extends from the eccentric-strap 194 into a slot 203 formed between the flange portions 167 and 168 of the movable structure 127.

In order to insure a rotative movement of the eccentric-strap 194 sufficient to actuate the movable contact elements out of engagement with the stationary contact elements, when the eccentric-strap shoulders 195 and 196 have been actuated clear of the retaining flange 197, in event of the inoperation of the spring 192, the eccentric 193 and eccentric-strap 194 are provided with cooperating shoulder portions 204 and 205 (Fig. 9), respectively, so that the eccentric-strap 194 is positively actuated by the actuating shaft 115 through the pawl and ratchet construction 187—191. Such actuation, however, is discontinued when the movable contact elements 181 and 182 of the limit switch 121 have been actuated clear of the cooperating stationary-contact elements, as will appear more fully hereinafter.

As the actuating shaft 115 is turned through one complete revolution, the pawl 190 engages the ratchet-wheel 187 causing the same to turn and wind up the spring 192. The movement of the ratchet-wheel 187, however, simultaneously causes a corresponding movement of the eccentric 193, resulting in a lateral movement of the eccentric-strap shoulders 195 and 196. When the ratchet-wheel 187 has moved through such angle as to establish the desired force in the spring 192, the shoulders 195 and 196 have been moved clear of the retaining flange 197, permitting the eccentric-strap 194 to turn rapidly under the action of the strained spring 192, carrying with it the movable switch structure 127 which is operatively associated therewith by means of the lug 202. Since the eccentric 193 is prevented from following the movement of the eccentric-strap 194 by reason of the engagement of the pawl 190 with the ratchet-wheel 187, the eccentricity of the eccentric 193 increases from the minimum value obtaining when the shoulder 195 is just actuated clear of the retaining flange 197 to the maximum value obtaining when the shoulder 195 engages the succeeding flange 198. Hence, as the eccentric shoulder 195 is moved from the retaining flange 197 to the next succeeding retaining flange 198, it is moved outwardly and finally engages the latter.

The cam 191 is so designed that, when the eccentric shoulder 195 engages the locking flange 198, the pawl 190 is actuated clear of the ratchet-wheel 187, thereby releasing the opposite end of the spring 192. The effect of releasing this end of the spring 192 is to cause the eccentric 193 to move in the opposite direction forcing the eccentric-strap 194 radially outwardly until the locking flange 198 is fully engaged by both of the eccentric-strap shoulders 195 and 196. The reverse movement of the eccentric 193 is limited by a pair of cooperating shoulders 206 and 207 formed on the eccentric-strap 194 and the eccentric 193, respectively, whereby tension is maintained on the spring 192 at all times.

When the shaft 115 is moved through another complete turn, the foregoing cycle of operation is repeated, so that the movable switch structure 127 may be successively actuated from one operative position to another for each complete turn of the actuating shaft 115. Attention is directed to the fact that the movement of the switch structure 127 from one operative position to another is very rapid, being in effect a snapping from one position to another. As hereinabove pointed out, should the spring 192 fail to move the movable contacts from any one circuit-closing position, the shoulder 204 of the eccentric 193 engages the shoulder 205 on the eccentric-strap 194 and, under the action of the actuating shaft 115, positively moves the movable switch structure 127 out of the circuit-closing position.

Referring to the diagrammatic embodiment of my invention shown in Fig. 13, the driving motor 9 is connected by conductors 208 and 209, which constitute the previously-noted motor-energizing-circuit 122, to the positive and negative bus conductors 211 and 212, respectively, of a distantly located control bus 213. The conductor 209 includes in series-circuit relation the master relay 46 shown in Fig. 5 as well as the actuating winding 47 thereof, so that the movable contact element 59 may be held in its circuit-closing position when winding 47 is energized. The conductor 209 also includes the limit switch 121, the stationary contact elements 145—155 and 158—162 thereof being connected, respectively, by jumpers 214 and 215 (Fig. 6).

The operation of the movable contact elements 181 and 182 of the limit switch 121, as the same are moved from one operative position to another, is merely to open and to close instantaneously the motor energizing circuit

122. This instantaneous opening and closing of the motor-energizing circuit 122, however, is sufficient to cause the deenergization of the actuating winding 47 of the master relay 46 and, as previously pointed out, results in the contact element 59 moving out of engagement with the stationary contact element 64 and 65 to completely interrupt the motor-energizing circuit 122.

A system of remote control 216 for the master relay 46 comprises a conductor 217 which extends from the conductor 208 through the actuating winding 49 to a jumper 218 of the switch 123, said jumper 218 connecting the stationary contact elements 144 and 154 in parallel relation. The remaining stationary contact elements 157 and 161 of this switch are connected by conductors 219 and 221 through remote-control switches 222 and 223, respectively, to a common conductor 224 electrically connected to the bus conductor 212. The remote-control switches 222 and 223 may be located at a distant operating station.

In order to indicate whether or not the high-voltage switch 1 is open or closed, I provide a pair of indicating lamps 225 and 226, which have corresponding terminals connected by conductors 227 and 228 to the bus conductors 212 and 211, respectively, the remaining terminals thereof being connected by conductors 229 and 231, respectively, to a common conductor 232 which terminates on a jumper 233 of the switch 124, the jumper 233 serving to connect in parallel relation the stationary contact elements 156 and 159. The remaining stationary contact elements 143 and 153 of this switch are connected by conductors 234 and 235, respectively, to the conductors 208 and 209.

When the remote-control switch 223 is closed, a circuit is completed which extends from the bus conductor 212 through the conductor 224, the remote-control switch 223, the conductor 221, the stationary and movable contacts elements 157—184, 183—144 of the switch 123, the conductor 217, the energizing winding 49 and the conductor 122 to the bus conductor 211. The effect of closing this circuit is, therefore, to cause the core member 48 to actuate the movable switch element 59 into engagement with the stationary-contact element 64 and 65 to complete the motor-energizing circuit 122.

The vertical movement of the core member 48 incident to the energization of the actuating winding 49 causes the release of the brake mechanism 34, as previously pointed out, whereby the motor 9 may revolve free of the same. The motor 9 then operates to turn the gear-wheels 73 and 99. When the gear-wheel 73 has moved through its effective portion of a revolution, the operating shaft 7 has been so moved as to actuate the high-voltage switch 1 from one operative position to another. The gear-wheel 73 fails to actuate the gear-wheel 99 during the remaining half-revolution by reason of the engagement of the smooth surface 111 thereof with the smooth portions 112 or 113 of the gear-wheel 99.

As the gear-wheel 73 moves through its effective portion of a revolution, the pawl 190 engages the ratchet-wheel 187 causing the twisting of the spring 192. This storage of energy in the spring 192 continues until the high-voltage switch mechanism 1 has been moved from one operative position to another at which instant the movable contact elements of the switches 121, 122 and 123 snap from engagement with one set of stationary-contact elements into engagement with a succeeding set of stationary-contact elements, as illustrated by the solid and dotted lines, respectively, in Fig. 13. The momentary interruption in the motor-energizing circuit 122 renders ineffective the actuating winding 47 with the result that the movable contact element 59 moves out of engagement with the stationary contact elements 64 and 65 to completely interrupt the motor circuit 122. The simultaneous dropping of the core 48 results in the application of the motor brake 34, so that the motor 9 is brought to rest without an undesirable amount of overtravel.

The operation of the switch 123 from the solid line position to the dotted line position causes the remote control switch 222 to become operative and the remote control switch 223 to become inoperative, inasmuch as the conductor 221 is now connected to a dead-end of the switch 123. Similarly, the operation of the switch 124 from the solid line position to the dotted line position renders effective the indicating lamp 225 and the indicating lamp 226 ineffective. When the high-voltage switch mechanism 1 is to be moved to its original position, the remote control switch 222 is actuated.

While I have shown only one embodiment of my invention for purposes of describing the same and illustrating the principles of construction and operation thereof, it is apparent that various changes and modifications may be made therein without departing from the spirit and scope of my invention, and I desire, therefore, that only such limitations shall be imposed thereon as are indicated in the appended claims or as are demanded by the prior art.

I claim:

1. In combination, a driven shaft, a driving shaft, mechanism for so operatively associating said driven shaft and said driving shaft that the former is intermittently actuated, a clutch for rendering ineffective said mechanism, whereby said driven shaft may be operated independently of said driving shaft, and a limit switch actuated by said driving shaft.

2. Apparatus of the character described

comprising a driving shaft, a limit switch operatively associated therewith, a driven shaft, intermittent gearing operatively associating said shafts, and a switch connected to be actuated by said driven shaft.

3. Apparatus comprising a driving shaft having a gear wheel, a driven shaft provided with a gear wheel, said gear wheels being so formed that one is intermittently actuated by the other, and a high voltage switch connected to be actuated by said driven shaft.

4. Apparatus of the character described comprising driving means, a switch to be actuated thereby, mechanism for operatively associating said driving means and said switch including intermittent mechanism, whereby said driving means may have a maximum range of travel independent of said switch, and a limit switch for controlling said driving means.

5. The combination with a high voltage switch to be actuated, of a driving motor, and means for operatively associating said motor and said switch comprising a worm-gear drive and intermittent gear-wheel mechanism connected to be actuated by said drive.

6. The combination with a high voltage switch to be actuated, of a driving motor, and means for operatively associating said motor and said switch comprising a worm-gear drive and intermittent gear-wheel mechanism connected to be actuated by said drive, said drive and said mechanism being interconnected by a clutch.

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