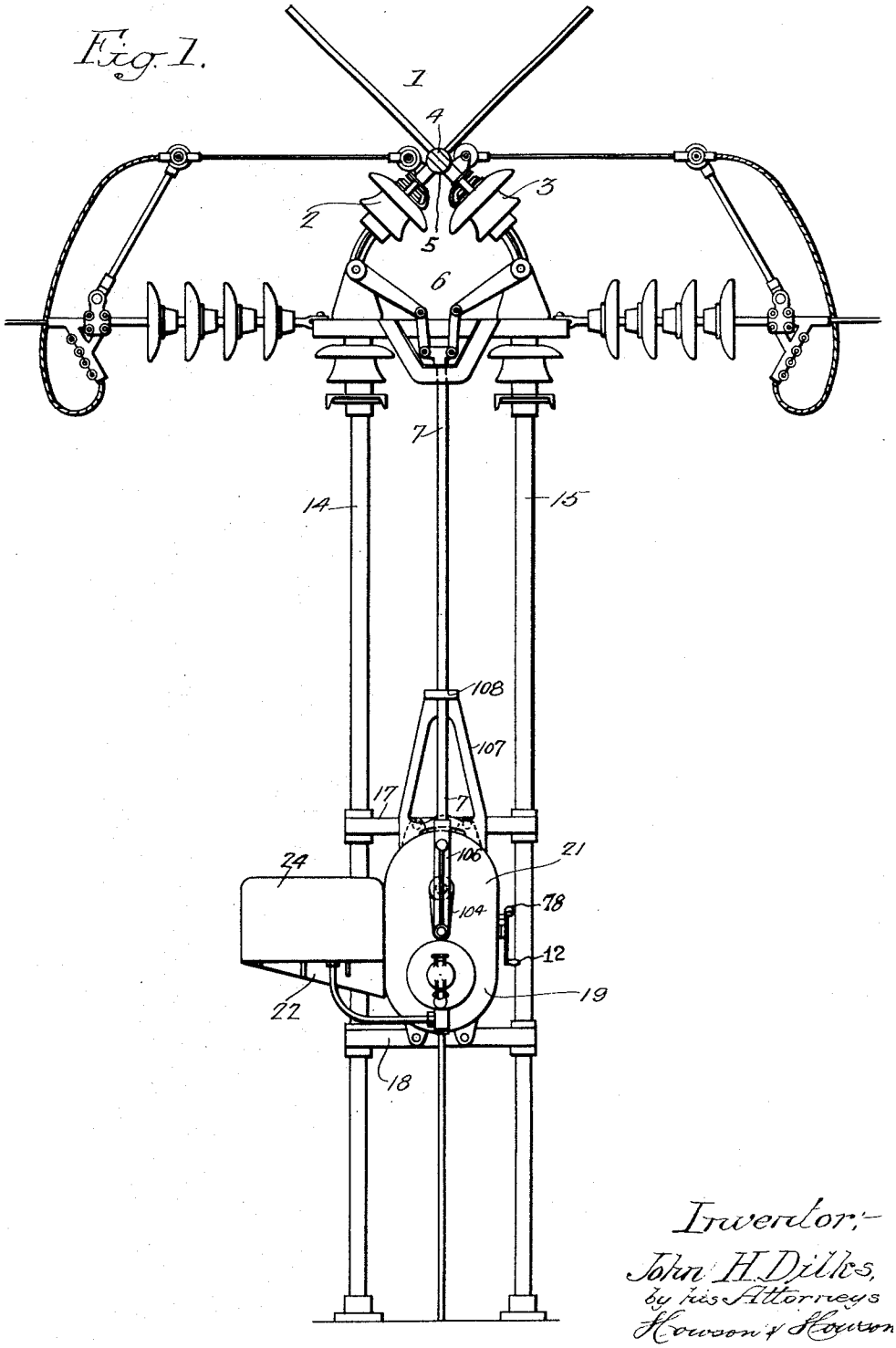
Sept. 18, 1928. 1,685,070

J. H. DILKS

SWITCH APPARATUS

Filed Aug. 16, 1927 5 Sheets-Sheet 1

Fig. 1.



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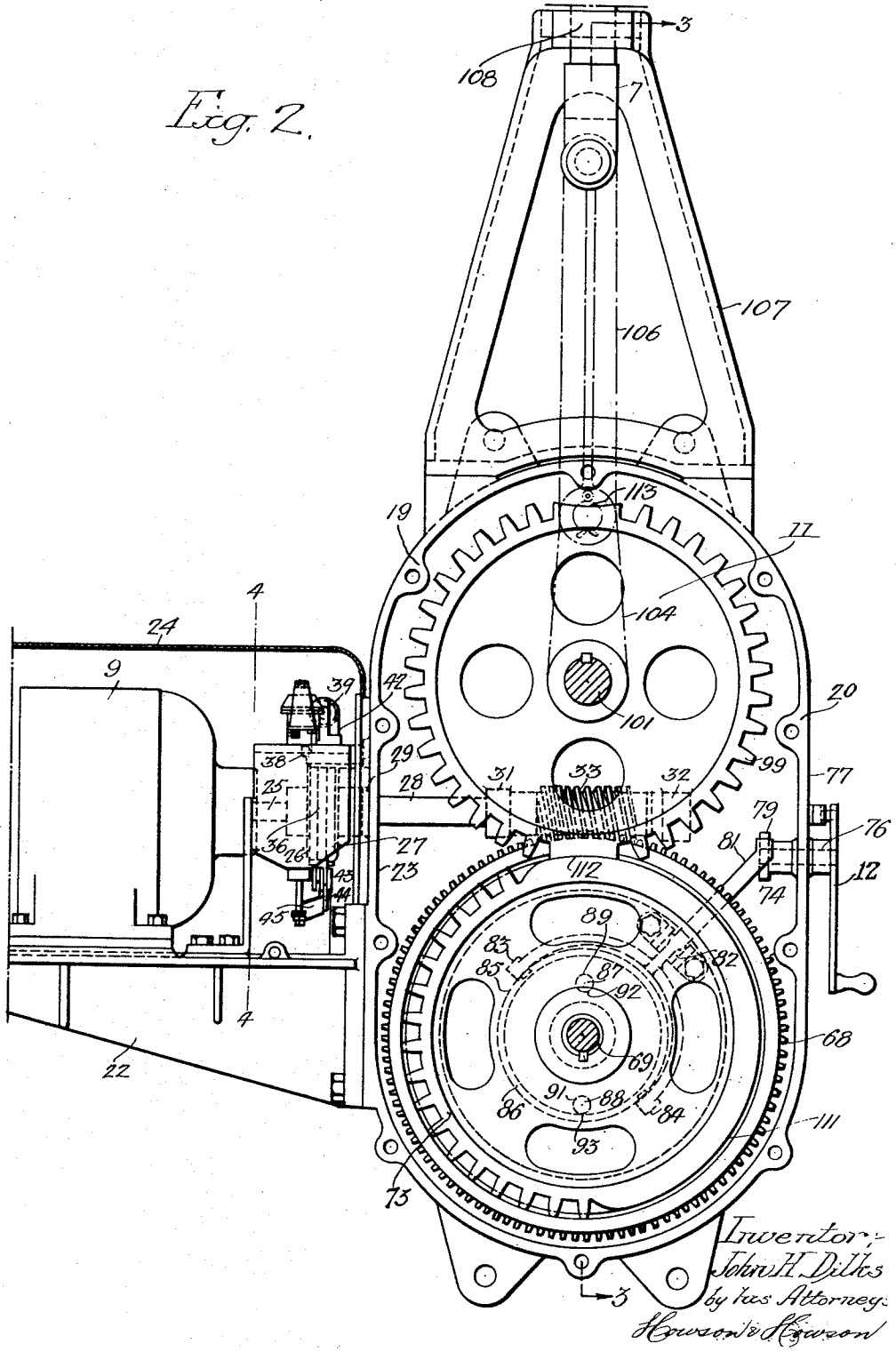
Sept. 18, 1928. 1,685,070

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SWITCH APPARATUS

Filed Aug. 16, 1927 5 Sheets-Sheet 2

Fig. 2.



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SWITCH APPARATUS

Filed Aug. 16, 1927 5 Sheets-Sheet 3

Fig. 3.

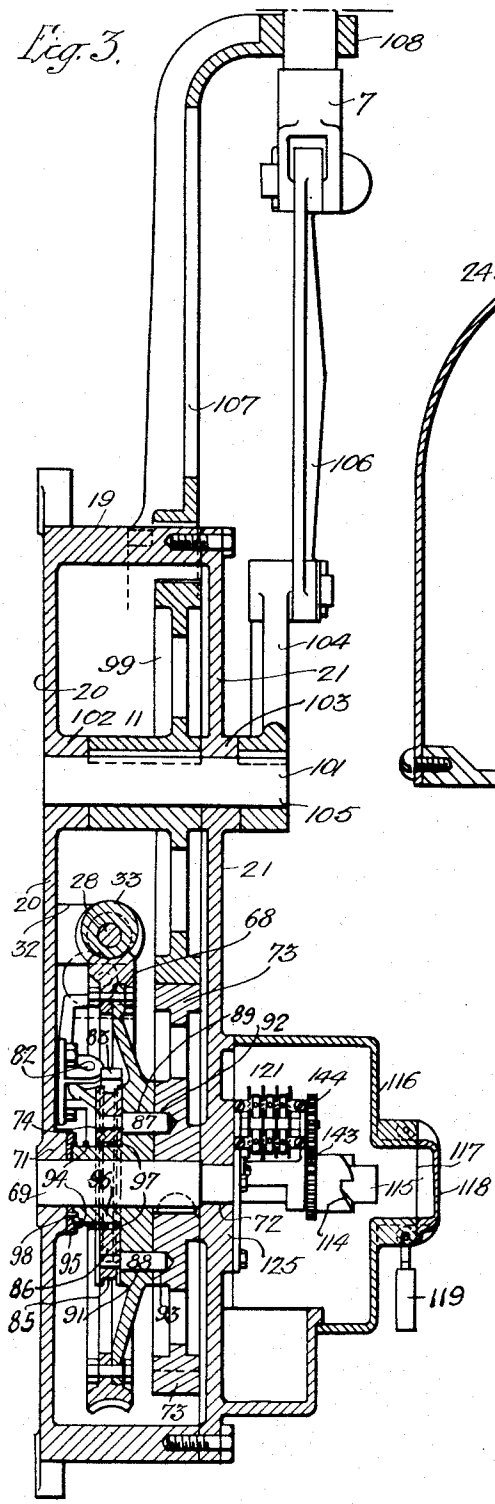
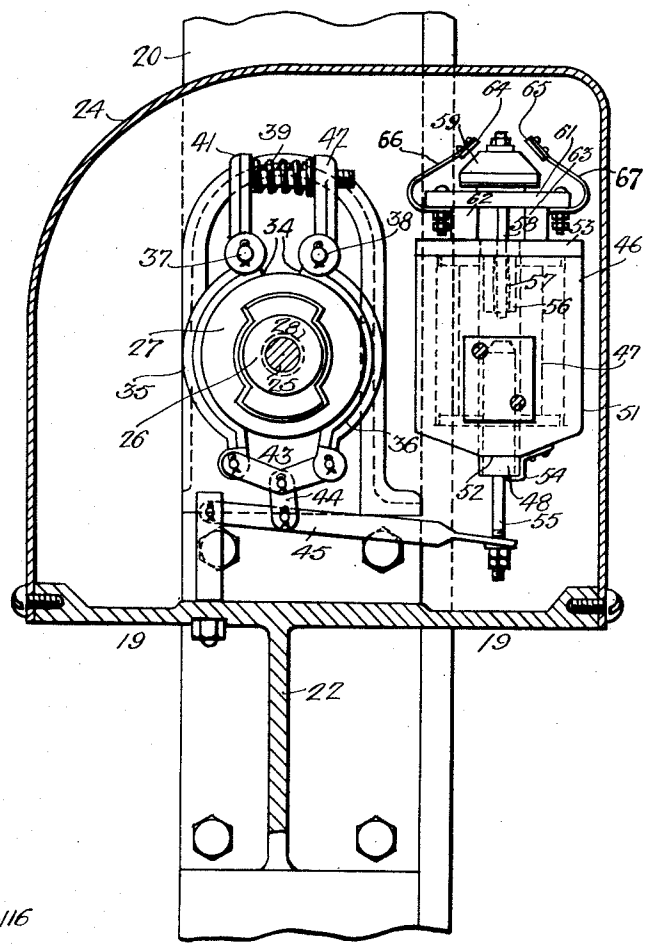


Fig. 4.



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Sept. 18, 1928. 1,685,070

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SWITCH APPARATUS

Filed Aug. 16, 1927 5 Sheets-Sheet 4

Fig. 5.

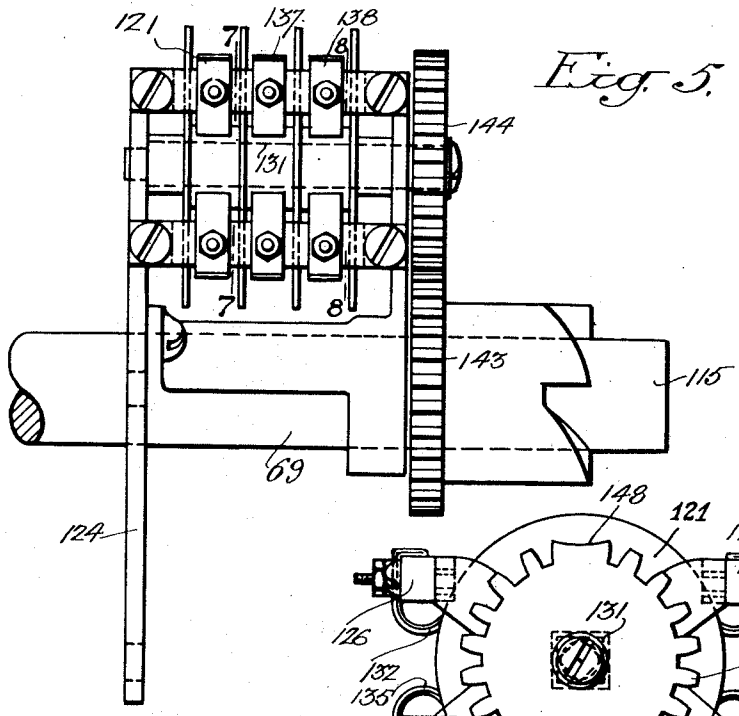


Fig. 6.

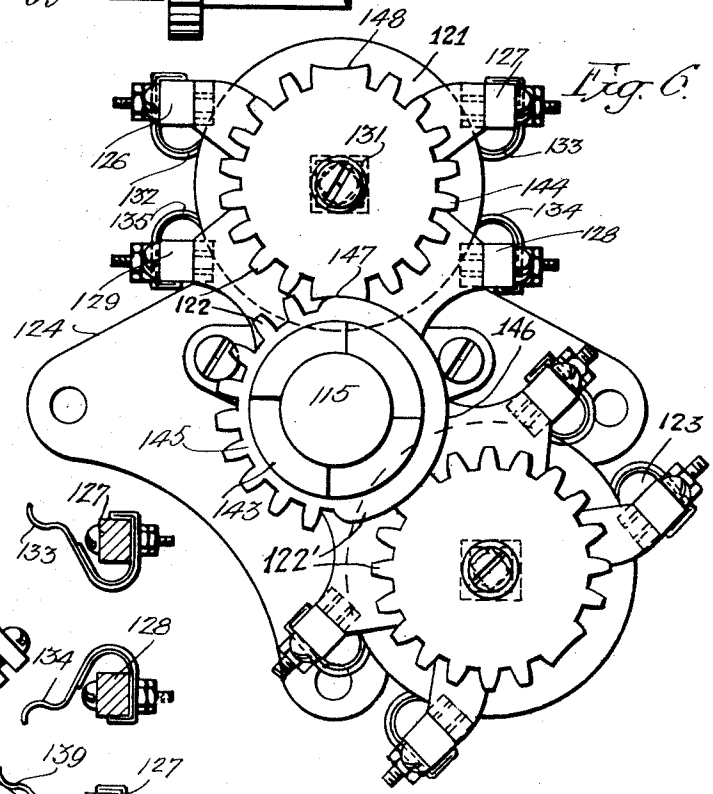


Fig. 7.

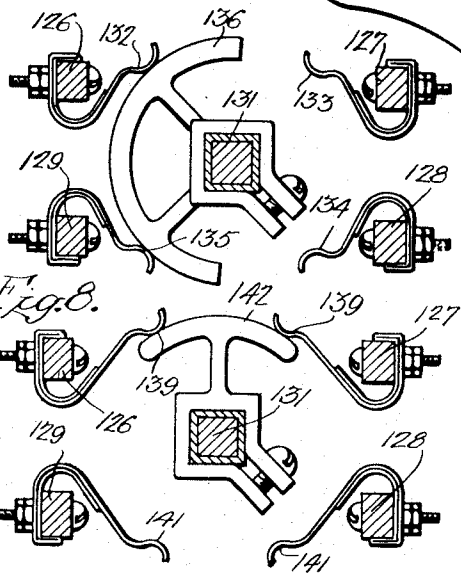


Fig. 8.

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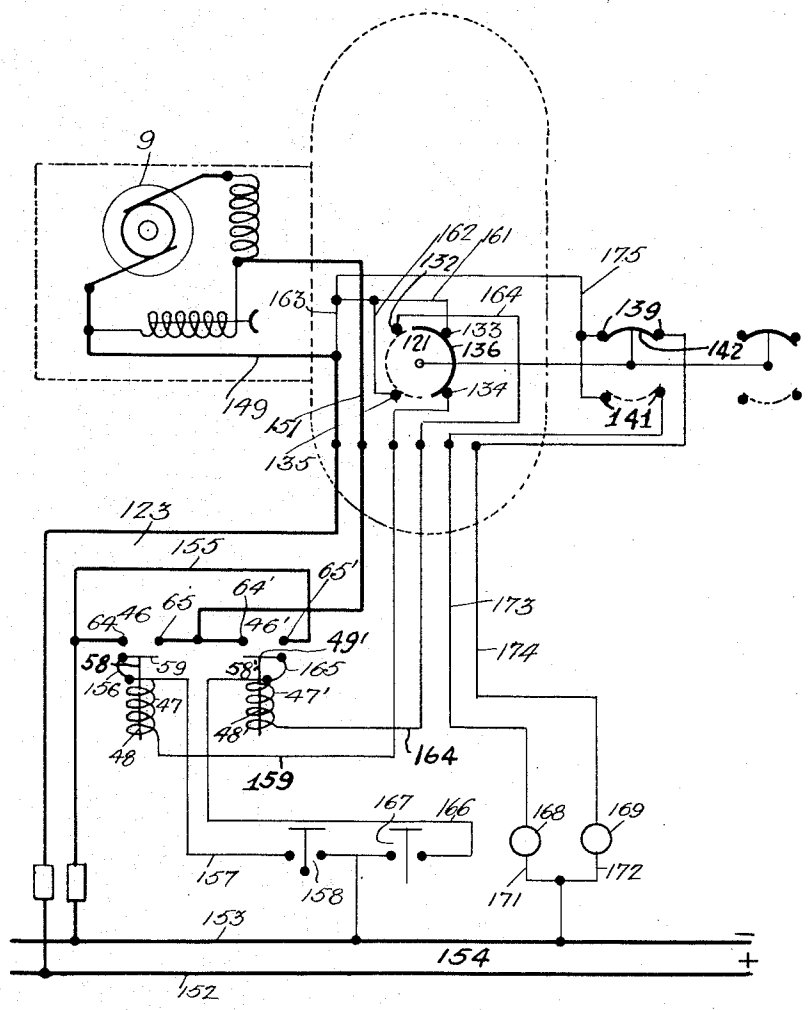
Sept. 18, 1928. 1,685,070

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SWITCH APPARATUS

Filed Aug. 16, 1927 5 Sheets-Sheet 5

Fig. 9.



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Patented Sept. 18, 1928. 1,685,070

UNITED STATES PATENT OFFICE.

JOHN H. DILKS, OF PHILADELPHIA, PENNSYLVANIA.

SWITCH APPARATUS.

Application filed August 16, 1927. Serial No. 213,313.

My invention relates to switches for electrical circuits, such, for example, as is set forth in my co-pending application, Serial No. 719,677, filed June 12, 1924, and assigned to Electric Power Equipment Corporation.

One object of my invention is to provide a combination comprising a switch to be operated, driving means for the switch, a simple and efficient limit switch for controlling the operation of the driving means, and intermittent mechanism for operatively associating the limit switch and the driving means.

Another object of my invention is to provide a switch construction comprising a high-voltage switch to be operated, a driving motor, means including intermittent mechanism for operatively associating the driving motor and the switch, a limit switch for controlling the operation of the driving motor, and intermittent gear-wheel mechanism extending between the limit switch and said means.

A further object of my invention is to provide a limit-switch construction for controlling the operation of a driving motor for a high-voltage switch that shall be characterized by its rapid opening and closing which is effected without the use of such secondary devices as cams, springs and releasing latches; by the elimination of shock incident to spring-operated constructions, such shock causing in time the crystallization and subsequent breaking of the parts; by the fact that the limit switch is locked in either its open or closed position and by the fact that the construction readily lends itself to multiplication.

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, when taken in connection with the following description, claims and 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 an enlarged, detail elevational view of the limit switch and associated intermittent actuating mechanism;

Fig. 6 is an end elevational view of the structure of Fig. 5 looking from the right but showing in addition a second limit switch;

Figs. 7 and 8 are transverse sectional views taken on the lines 7—7 and 8—8 of Fig. 5, respectively; and

Fig. 9 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 co-operating 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 12 (Fig. 2) has been moved to disengage the driving motor 9 from the associated mechanism 11, all as will appear more fully hereinafter.

The switch mechanism 1 may be mounted on a tower (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. The 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 bearings 31 and 32.

In order to avoid overtravel of the motor 9, when the high-voltage switch 1 has been actuated into either of its positions, I pro-

vide 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 27 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 pair of master relays 46—46′, of which one only is shown in Fig. 4. In Fig. 9, however, these two relays and associated circuits are shown diagrammatically. Considering the relay 46 in detail, an actuating winding 47 of cylindrical form surrounds a central core member 48. The actuating winding 47 as well as the movable core member 48 may be enclosed by a casing 51 of magnetic material, the latter having an opening 52 in the base thereof for the movable core member 48. The upper 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 cover member 53 of the casing 51 is provided with an axial projection 56 extending into the base of the winding 47, the projection 56 being provided with an axial perforation 57 adapted to receive slidably a stem 58 which carries 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 upper side of the cover member 53. A pair of stationary contact members 64 and 65 are mounted directly above the co-operating 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 the winding 47 is energized, as will presently appear. The effect therefore of energizing the winding 47 is to cause a vertical movement of the core member 48, which results in the closing of the relay 46 and the simultaneous release of the brake 34, permitting the motor 9 to revolve freely. The other relay 46′ is identical in all respects with the relay 46 just described, comprising an actuating winding 47′, a movable core 48′, a movable contact member 49′, which is mounted on the upper end of a stem 58′, and spaced stationary contact members 64′ and 65′. The relay 46′ also is connected to the brake-releasing lever 45.

The worm 33 (Figs. 2 and 3) is actuated by the driving motor 9 and it 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, respectively, of the gear casing 19. 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 the clutch handle or lever 12 which is rigidly secured to a short shaft 76 journaled in a side 77 of the gear casing 19. The handle 12 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 extending into 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 12 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 rotary 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 are 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-wheels 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 73.

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 operation of the clutch-releasing handle 12 by an operating handle (not shown) which is adapted to engage teeth 114 formed on the outer end of an extension 115 of the drive shaft 69. The extension 115 of the shaft 69 may be enclosed by a casing 116 a part of which constitutes an integral projecting portion of the removable cover 21. Access may be had to the teeth 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 move the same from one operative position to another, it becomes necessary to render the motor 9 automatically ineffective upon the completion of such movement. In accordance with my invention, I provide a simple and efficient form of limit switch 121 and intermittent actuating mechanism 122, whereby a motor-energizing circuit 123 (Fig. 9) may be automatically opened and closed in accordance with the operation of the driving motor 9. The intermittent mechanism 122 is characterized by the fact that it causes the rapid opening and closing of the limit switch 121 without the use of secondary devices, such, for example, as cams, springs and releasing latches. Moreover, the mechanism 122 constitutes locking means for holding the limit switch 121 in either its open or its closed position, and it also serves to prevent over or under travel, thereby assuring the correct timing of the switch 121. In addition, shocks characteristic of spring-operated constructions are eliminated, together with attendant crystallization and subsequent breakage of parts. As shown in Fig. 6, the construction readily lends itself to multiplication, a second switch 123 being illustrated as actuated according to a predetermined cycle independently of the switch 121 by intermittent gear-wheel mechanism 122′ having one part in common with the mechanism 122.

Considering the limit switch 121 and its operating means in greater detail, as shown in Figs. 5 to 8, inclusive, a base plate 124, which is adapted to be secured to an outer side portion 125 (Fig. 3) of the gear cover 21 is provided with a plurality of outwardly projecting contact carrying arms 126, 127, 128 and 129 and an intermediate, centrally disposed shaft member 131. A plurality of stationary contacts 132, 133, 134 and 135 are mounted on the arms 126, 127, 128 and 129, respectively, and constitute the stationary contact elements of the limit switch 121. An arcuate contact member 136 is insulatingly mounted on the rotor shaft 131 in co-operative relation to the stationary contact members just described and constitutes the movable element of the limit switch 121. As shown in Fig. 7, the rotary contact member 136 is of such length as to bridge adjacent

pairs of stationary contact elements. The connection of these elements in the remaining portion of the circuit is shown in Fig. 9 which will be described hereinafter. Additional switches 137 and 138 may be provided, each comprising pairs of stationary contact elements 139 and 141 and a co-operating rotary member 142, as shown in Fig. 8 which is a section on the line 8—8 of Fig. 5.

As noted above, one of the features of my invention is the provision of simple and reliable actuating means 122 for the switches 121, 137 and 138. This means comprises a pair of intermittent gear-wheels 143 and 144 which are respectively mounted on the extended portion 115 of the drive shaft 69 and the switch shaft 131. The gear-wheel 143 is provided with a tooth portion 145 extending around one-half the periphery thereof and a smooth surface portion 146 extending over the remaining half thereof. The co-acting driven gear-wheel 144 is provided with oppositely positioned smooth portions 147 and 148 which are formed on the periphery thereof and adapted to engage successively the smooth portion 146 of the gear-wheel 143. The remaining peripheral portions of the gear-wheel 144 are provided with teeth which mesh with the tooth portion 145 of the driving gear-wheel 143.

The smooth portions 146, 147 and 148 are so designed that the teeth of the driving gear-wheel 145 engages the teeth of the gear-wheel 144 for one-half a revolution only, during which periods the rotor sector 136 is actuated out of engagement with one pair of stationary contact members of the limit switch 121 and into engagement with the other pair, resulting in the de-energization of the driving motor 9, as will appear more fully hereinafter. During the remaining half revolution of the driving gear-wheel 145, the smooth portion 146 thereof slides over one of the co-acting smooth portions 147 and 148 of the driven gear-wheel 144 without causing the actuation of the latter gear-wheel. The gear-wheel 144, therefore, is locked in position, except when it is positively actuated by the driving gear-wheel 145. The gear-wheels 144 and 145 are so adjusted with respect to the gear-wheels 73 and 99 and the crank 104 that the limit switch 121 causes the opening or closing of the motor circuit 123 only when the driving motor 9 has actuated the switch 1 into its open or closed position.

Referring to Fig. 9, the driving motor 9 is connected by conductors 149 and 151, which constitute the previously-noted motor-energizing circuit 123, to positive and negative bus conductors 152 and 153, respectively, of a distantly located control bus 154. The conductor 151 includes the spaced stationary contact members 64 and 65 of the relay 46, while a conductor 155, which is connected in shunt to these contact members, includes the spaced stationary contact members 64′ and 65′ of the relay 46′.

The actuating winding 47 of the relay 46 has one terminal thereof connected by conductor 156 to the movable contact member 59. The same terminal is also connected by a conductor 157 to the negative bus conductor 153 through a push-button switch 158. The other terminal of the actuating winding 47 is connected by a conductor 159 to the stationary contact members 134 of the limit switch 121. The stationary contacts 133 and 135 are respectively connected by conductors 161 and 162 to a common conductor 163 extending to the positive conductor 149 of the motor energizing circuit 123. The remaining stationary contact members 132 of the limit switch 121 is connected by a conductor 164 to one terminal of the actuating winding 47′ of the relay 46′. An opposite terminal of the winding 47′ is connected by a conductor 165 to the movable contact member 59. This terminal is also connected by a conductor 166 to the negative bus conductor 153 through a manually operable control switch 167.

In order to indicate whether or not the high-voltage switch 1 is open or closed, I provide a pair of indicating lamps 168 and 169, corresponding terminals of which are respectively connected by conductors 171 and 172 to the negative bus conductor 153. The remaining terminals of the indicating lamps 168 and 169 are respectively connected by conductors 173 and 174 to the stationary contact members 141 and 139 as shown in Fig. 9. The contact members 139 and 141 are also connected by a conductor 175 to the conductor 163 leading to the motor-energizing circuit 123,—the arrangement of these parts being such that when the movable contact member 142 is in the solid-line position shown in Fig. 9, the lamp 169 only is energized and the switch 1 is open, but when in the dotted-line position, the lamp 168 is effective and the switch 1 is in its closed position.

In operation, when the remote control switch 158 is closed, a circuit is completed which extends from the positive bus-bar conductor 152 through the conductor 149, the conductor 161, the pair of stationary contact elements 133—134 and the movable contact member 136 of the limit switch 121, the conductor 159, the relay actuating winding 47, the conductor 157, and the push button switch 158, to the negative bus-bar conductor 153. The effect of closing the circuit is to cause the core member 48 to actuate the movable contact 59 into engagement with the stationary contact members 64 and 65, thereby completing the motor energizing circuit 123.

The vertical movement of the core member 48 incident to the energization of the

actuating winding 47 causes the release of the brake mechanism 34, as previously described, so that the motor 9 now revolves freely. The operation of the motor 9 causes the turning of the intermittent gear-wheel mechanism 73, 99. When the gear-wheel 73 has moved through its effective portion of a revolution, the switch operating crank 104 has actuated the high-voltage switch 1 from its open position to its closed position shown in Fig. 1. 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 portion 111 thereof with one of the smooth surface portions 112, 113 of the gear-wheel 99.

As the gear-wheel 73 moves through its effective portion of a revolution, wherein the switch 1 is moved from its open position to its closed position, the toothed portion 145 of the limit-switch operating mechanism 122 engages one of the toothed portions of the driven gear-wheel 144, causing the turning of the rotor shaft 131 and consequently the actuation of the rotary contact member 136 from the solid-line position of Fig. 9 to the dotted-line position. Such movement interrupts the energizing circuit of the relay actuating winding 47, causing the movable contact member 59 to drop out of engagement with the stationary contact members 64 and 65. The consequent interruption of the motor energizing circuit 123 causes the deenergization of the driving motor 9, while the dropping of the core member 48 results in the application of the motor brake 34, so that the motor 9 is brought to rest without an undesirable amount of over travel. Such over travel as does occur, however, does not cause the further operation of the switch 1 by reason of the fact that the smooth portion 111 of the gear-wheel 73 is in engagement with one of the smooth portions 112—113 of the gear-wheel 99. Over travel of the driving gear-wheel 145 also fails to cause the operation of the limit switch 121 for the reason that the smooth portion 146 of the driving gear-wheel 145 is in engagement with one of the co-acting smooth portions 147—148 of the gear-wheel 144.

The movement of the rotary member 136 of the limit switch 121 from the solid-line position of Fig. 9 to the dotted-line position causes the remote control switch 167 to become operative and the remote control switch 158 to become inoperative. If the switch 167 is now closed, a circuit is completed through the contact members 132, 136 and 135 of the limit switch 121, the actuating winding 47′ of the relay 46′ and the push button switch 167, resulting in the motor circuit 123 being again energized. Accordingly, the switch 1 is actuated from its closed position into its open position, but at the same time, the movable contact members 136 of the limit switch 121 is actuated from the dotted-line position of Fig. 9 to the solid line position originally described, thereby causing the de-energization of the relay 47′ and the consequent inoperation of the driving motor 9. The further operation of the switch 1 is as first described, being now controlled by the push button switch 158.

While I have shown only one embodiment of my invention, for the purpose of describing the same and illustrating its principles of construction and operation, it is apparent that various changes and modifications may be made therein, without departing from the spirit 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. The combination with driving means, a switch to be actuated and mechanism for operatively associating said driving means and said switch, of a limit switch and intermittent gearing for operatively associating said limit switch and said mechanism, whereby said limit switch may control the operation of said driving means.

2. Apparatus of the character described comprising a switch to be actuated, a driving motor for said switch, a limit switch, and means including intermittent gearing for operatively associating said driving motor and said limit switch, whereby the latter may control said driving motor.

3. Apparatus of the character described comprising a driving shaft, a limit switch, intermittent gearing for operatively associating said switch and said shaft, a driven shaft, intermittent gearing for operatively associating said shafts, and a switch connected to be actuated by said driven shaft.

4. The combination with a driving shaft having a gear-wheel, of a driven shaft provided with a gear-wheel, said gear-wheels being so formed that one is intermittently actuated by the other, a high-voltage switch connected to be actuated by said driven shaft, a limit switch, and intermittent gearing extending between said limit switch and said driving shaft.

5. The combination with a high-voltage switch, a driving motor and means for operatively associating said motor and said switch comprising a worm wheel drive and intermittent gear-wheel mechanism, of a limit switch for said motor, and means for connecting said limit switch and said worm-wheel drive including intermittent mechanism.

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

atively associating said worm-wheel drive and said limit switch, and a clutch for operatively associating said worm-wheel drive and at least one of said intermittent mechanisms.

7. In combination, a driven shaft, a driving shaft, mechanism for so connecting said shafts that said driven shaft is intermittently actuated, a clutch for rendering ineffective said mechanism, whereby said driven shaft may be operated independently of said driving shaft, a limit switch and intermittent gear-wheel mechanism for connecting said limit switch and said drive shaft.

8. In a high-voltage switch structure, the combination with a main switch, of a driving motor, means for operatively associating said motor and said main switch including intermittent gear-wheel mechanism, a limit switch for said driving motor, intermittent gear-wheel mechanism operatively associated with said driving motor and said limit switch, a switch and an operating gear-wheel for said last-mentioned switch positioned to mesh intermittently with one of the gear-wheels of said second-mentioned mechanism.

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