Jan. 5, 1960 J. J. LAWICK 2,920,151

DOOR OPERATING ELECTRIC SWITCH

Filed Jan. 24, 1957 2 Sheets-Sheet 1

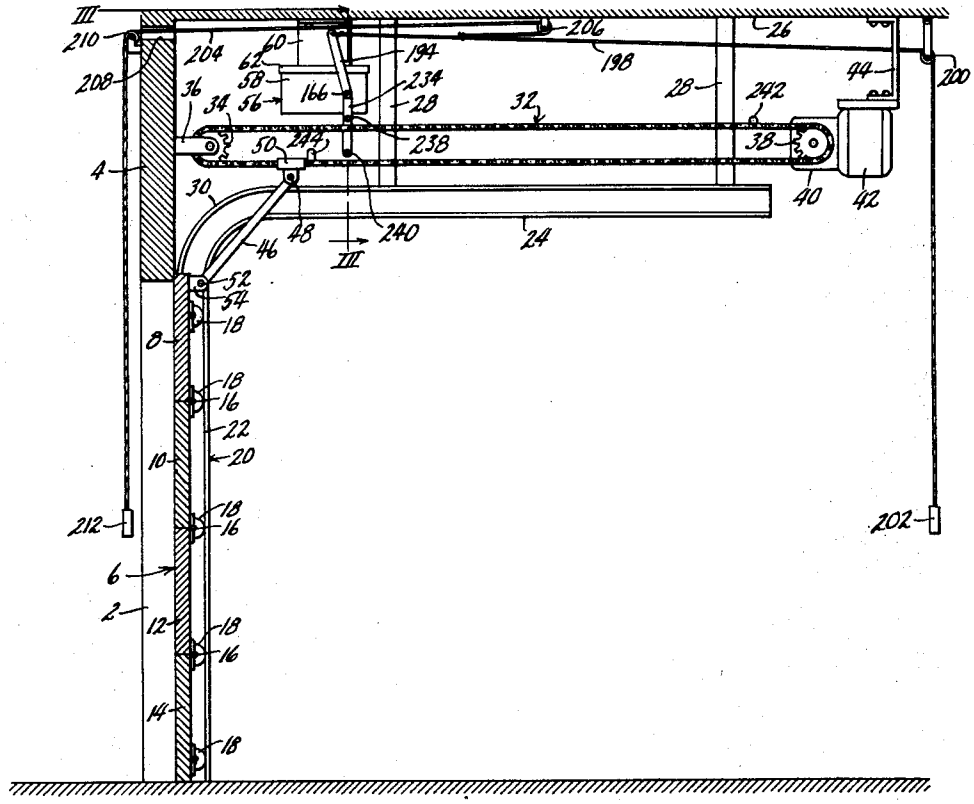


Fig. 1

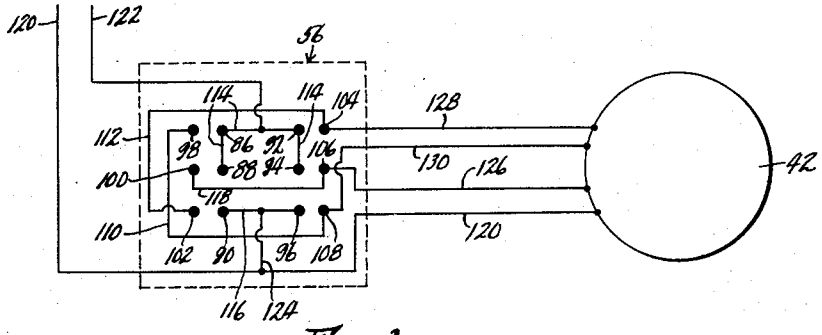


Fig. 2

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Fig. 3

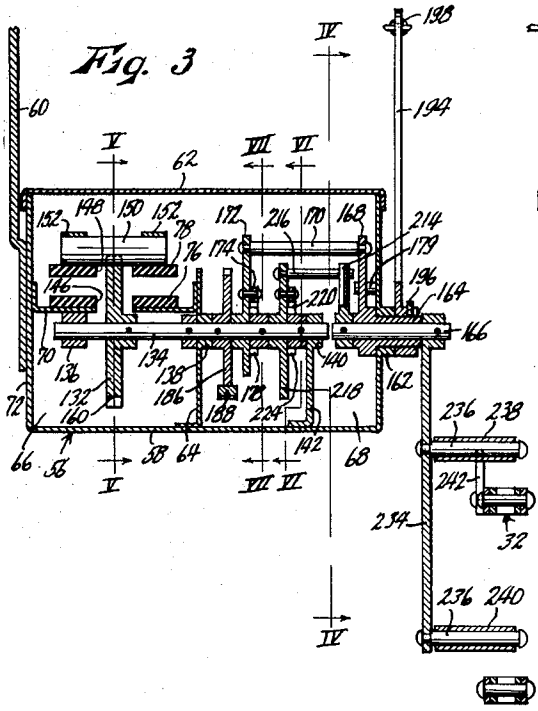


Fig. 4

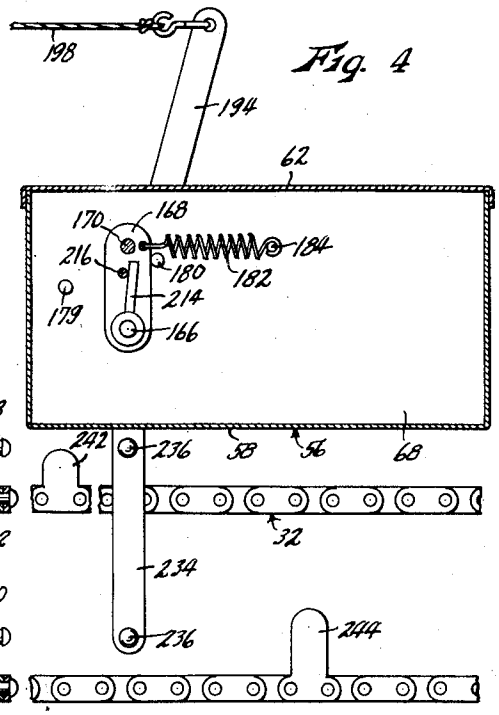


Fig. 5

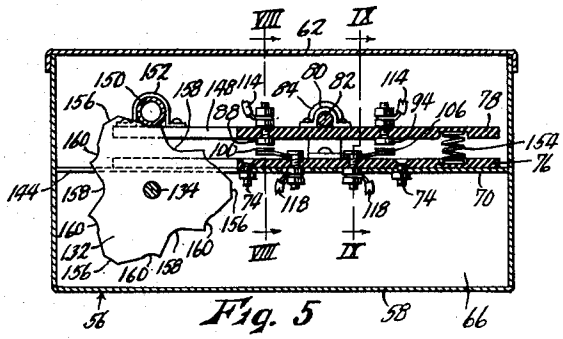


Fig. 6

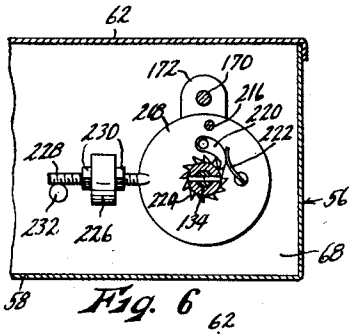


Fig. 8

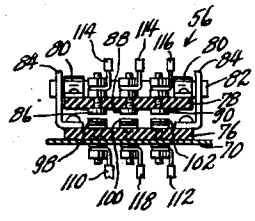


Fig. 9

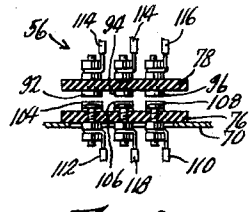
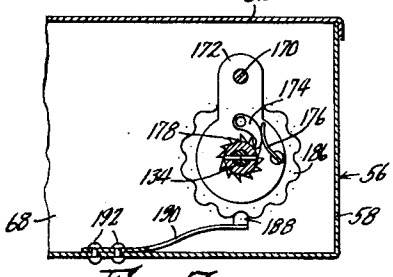


Fig. 7



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DOOR OPERATING ELECTRIC SWITCH

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5 Claims. (Cl. 200—17)

This invention relates to new and useful improvements in operating systems for power-operated doors, and has particular reference to motor operated doors of the type commonly used on garages and the like.

The principal object of the present invention is the provision of an electric switch for controlling a motor which operates a door, said switch containing a single set of contacts which function both as a manual control for starting, stopping, and reversing the motor, and also as a limit control which stops the motor automatically whenever the door is fully opened or fully closed. Thus full and complete operation and control of door is concentrated in a single switch.

Another object is the provision of a switch as described above which is well adapted to manual control from a plurality of stations, such as both inside and outside the garage, or at positions accessible to the driver of an automobile without dismounting from the automobile.

Other objects are simplicity and economy of construction, safety, convenience, and dependability of operation, and adaptability of the switch to be incorporated in many pre-existing door operating systems.

With these objects in view, as well as other objects which will appear in the course of the specification, reference will be had to the drawing, wherein:

Fig. 1 is a vertical sectional view of a garage door and related parts of a garage structure, showing an operating system for said door including a switch embodying the present invention,

Fig. 2 is a wiring diagram of the switch and motor,

Fig. 3 is an enlarged, fragmentary, slightly irregular sectional view of the switch taken on line III—III of Fig. 1,

Figs. 4 and 5 are sectional views taken respectively on lines IV—IV and V—V of Fig. 3,

Figs. 6 and 7 are fragmentary sectional views taken respectively on lines VI—VI and VII—VII of Fig. 3, and

Figs. 8 and 9 are fragmentary sectional views taken respectively on lines VIII—VIII and IX—IX of Fig. 5.

Like reference numerals apply to similar parts throughout the several views, and the numeral 2 applies to the door opening of a building wall 4, said door opening being provided with a conventional vertically movable door 6 divided horizontally into a plurality of sections 8, 10, 12 and 14, said sections being pivotally joined together by hinges 16. Along its vertical side edges, said door is provided with a plurality of rollers 18, which are engaged in guide tracks 20. The track at only one side of the door is shown, but it will be understood that there is a track at each side of the door. Each track has a vertical portion 22 affixed to wall 4 adjacent one side of door opening 2, and a rearwardly extending horizontal portion 24 supported from the building ceiling 26 by hangers 28, said horizontal and vertical portions being connected by a curved portion 30. In opening, the door

moves upwardly and rearwardly, rollers 18 being guided in tracks 20, until the door opening 2 is uncovered.

The door is operated by an endless chain 32 disposed in an elongated loop which is disposed above, intermediate and parallel to horizontal track portions 24. The forward end of said loop is trained over a sprocket 34 rotatably mounted in a bracket 36 affixed to wall 4, and the rearward end of said loop is trained over a sprocket 38 which is rotatably driven by a gear reduction unit 40 powered by a reversible electric motor 42 mounted to ceiling 26 by means of a suitable bracket 44. A link 46 is pivoted at one end as at 48, to a clamp 50 rigidly fixed on chain 32, and is pivoted at its opposite end, as at 52, to a bracket 54 fixed to the uppermost door section 8. Thus when motor 42 is operated in one direction, chain 32 will move clamp 50 rearwardly, pulling link 46 to open the door. When the motor is operated in a reverse direction, the action is reversed to close the door.

Motor 42 is controlled through an electrical switch indicated generally by the numeral 56 and including a rectilinear box-like housing 58 which is disposed above and adjacent chain 32 just rearwardly from sprocket 34. Said housing is attached to ceiling 26 by a suitable bracket 60, and is provided with a removable cover 62. Referring to Fig. 3, it will be seen that housing 58 is divided by a vertical partition 64 into two chambers, chamber 66 generally containing the electrical contact members of the switch, and chamber 68 generally containing the operating mechanism of the switch. Chamber 66 is divided by a horizontal shelf 70 affixed to partition 64 and side wall 72 of the housing.

Attached to the upper surface of shelf 70 by bolts 74 is an elongated sheet 76 of insulating material which serves as a switch base. Disposed in spaced relation above said base, and generally coextensive therewith, is a switch arm 78 which is also formed of insulating material, and which is pivoted by means of brackets 80 to a horizontal shaft 82 which extends transversely to switch arm 78. Said shaft is supported at its ends respectively by a pair of standards 84 which are fixed at their lower ends to base 76. In spaced relation from one side of shaft 82, three contact buttons 86, 88 and 90 are fixed in switch arm 78, and at the same distance to the opposite side of shaft 82 three contact buttons 92, 94 and 96 are affixed in the switch arm. Affixed in base 76 below buttons 86, 88 and 90, and cooperating respectively therewith, are three spring contacts 98, 100 and 102, and beneath buttons 92, 94 and 96 spring contacts 104, 106 and 108 are mounted in base 76. Internally of the switch, as diagrammed in Fig. 2, contacts 98 and 108 are connected by wire 110, contacts 102 and 104 are connected by wire 112, contacts 86, 88, 92 and 94 are connected by wire 114, contacts 90 and 96 are connected by wire 116, and contacts 100 and 106 are connected by wire 118.

Electric line wires are indicated at 120 and 122 in Fig. 2. Wire 120 is connected to one of the rotor winding terminals of motor 42, and is connected to wire 116 by wire 124. The other rotor winding terminal of the motor is connected by wire 126 to switch contact 106. The two field winding terminals of the motor are connected by wires 128 and 130 respectively to switch contacts 104 and 108. Line wire 122 is connected directly to wire 114. It will be understood that motor 42 is of a type which may be reversed by reversing the polarity of the field windings thereof.

When switch arm 78 is parallel to base plate 76 thereof, as in Fig. 5, none of the contacts in said switch arm engage any of the contacts in said base, and motor 42 is of course inoperative. This may be termed the "neu-

tral" or "off" position of the switch. When the switch bar is tilted in a clockwise direction as viewed in Fig. 5, contacts 92, 94 and 96 engage contacts 104, 106 and 108 respectively. This completes a motor rotor circuit from line wire 122 through wire 114, contacts 94 and 106, wire 126 and motor 42 to line wire 120, and a motor field circuit from line wire 122 through wire 114, contacts 92 and 104, wire 128, motor 42, wire 130, contacts 108 and 96, and wires 116 and 124 to line wire 120. The motor is thus energized to turn motor 42 in one direction, say to lower or close door 6. When switch bar 78 is tilted in a clockwise direction as viewed in Fig. 5, contacts 96, 88 and 90 engage contacts 98, 100 and 102 respectively. This completes a motor rotor circuit from line wire 122 through wire 114, contacts 88 and 100, wire 118, contacts 94 and 106, wire 126, and motor 42 to line wire 120, and a motor field circuit from line wire 122 through wire 114, contacts 86 and 98, wires 110 and 130, motor 42, wires 128 and 112, contacts 102 and 90, and wires 116 and 124 to line wire 120. Thus the polarity of the rotor circuit is not affected, while that of the field circuit is reversed. The motor thus turns in the opposite direction to raise door 6.

Switch arm 78 is controlled by a generally triangular cam 132 best shown in Figs. 3 and 5. Said cam is fixed on a shaft 134 which is parallel to shaft 82 and disposed beneath shelf 70 adjacent one end of the switch arm, being journalled in a bearing 136 affixed to the lower surface of said shelf, and in a bearing 138 affixed to partition wall 64. Said shaft also extends into chamber 68 of housing 58, and is journalled therein at its extreme end in a bearing 140 supported from the floor of the housing by standard 142. Cam 132 extends upwardly through a slot 144 formed in shelf 70, and through slots 146 and 148 formed respectively in the end portions of switch base 76 and switch arm 78. Said cam operatively engages a tubular follower 150 which is parallel to shaft 134 and which is secured to the upper surface of the switch arm by brackets 152. Said follower is urged against the cam by a compression spring 154 disposed between the end portions of the switch base and arm opposite from the cam, as best shown in Fig. 5.

Also as shown in Fig. 5, cam 132 is generally triangular, having at each apex thereof a flat 156 which is operable, when turned to engage follower 150, to tilt the switch arm in a clockwise direction, whereby to energize motor 42 to lower the door, as previously described. Midway along each edge, the cam is provided with a notch 158 which when turned to engage cam follower 150, allows the switch arm to be tilted in a counterclockwise direction by spring 154, thereby closing the switch to energize motor 42 to raise door 6. Midway between each notch 158 and each of the adjacent apexes of the cam, the cam is provided with a notch 160 which when in engagement with the cam follower positions the switch arm parallel with switch base 76, in which position the switch is open as previously described. It will thus be seen that cam 132 has twelve positions, spaced 30 degrees apart, and corresponding consecutively, in terms of motor operation, to forward, off, reverse, off, forward, off, etc.

Journalled in a bearing 162 carried by a side wall of housing 58 is a hollow sleeve 164 which is concentric with shaft 134, and journalled in said sleeve is a shaft 166 which is disposed in end-to-end relation with shaft 134. Fixed to the inner end of said sleeve is a radial arm 168, the outer end of which is rigidly connected by a rod 170 parallel to shaft 166 to an arm 172 which is journalled for free rotation on shaft 134. As best shown in Fig. 7, a dog 174 pivoted on arm 172 is urged by leaf spring 176, also carried by arm 72, into engagement with a 12-tooth ratchet wheel 178 fixed on shaft 134. The movement of arm 168 is limited to an arc of 30 degrees or slightly more, by a pair of pins 179 and 180 fixed in the side wall of the housing (Fig. 4), and said arm is urged against pin 180 by a spring 182 (Fig. 4) attached at one end to said arm and at its opposite end to a pin 184 fixed in the housing. Thus when arm 168 is pivoted against spring 182 to rest against pin 179, dog 174 turns ratchet 178, and shaft 134 30 degrees in a clockwise direction as viewed in Fig. 7, and advances cam 132 one station in a counter-clockwise direction as viewed in Fig. 5. When arm 168 is released it is returned against stop pin 180 by spring 182, during which movement dog 174 rides inoperatively over ratchet wheel 178.

It will be seen that in order to insure proper operation of the ratchet, the stop pins 179 and 180 should be set to allow slightly greater than 30 degrees of rotation by the ratchet. In order to prevent any error in the placement of cam 132 by the ratchet due to such overtravel, and also to prevent positively any rotation of shaft 134 by the return stroke of ratchet dog 174, there is fixed to shaft 134 a star wheel 186 having twelve equally spaced notches in the periphery thereof. Said notches are engaged selectively by a tooth 188 affixed to the free end of a leaf spring 190 which is fixed at its opposite end to the floor of housing 58 by rivets 192. The notches of the star wheel correspond accurately to the stations of cam 132, and the force of tooth 188 will turn shaft 134 to correct any slight mis-positioning of the cam due to overtravel of the ratchet.

Arm 168 is oscillated manually by an arm 194 affixed to the outer end of sleeve 164, externally of the housing, by set screw 196. A pull cord 198 is connected to the free end of arm 94, and is trained over a pulley 200 mounted on building ceiling 26 and is provided at its end with a handle 202. Another cord 204 is tied to cord 198, passed over a pulley 206 also mounted on ceiling 26, trained through an opening 208 in garage wall 4 and over a pulley 210 mounted on the front of the garage and is provided at its end with a handle 212. It will be apparent that by pulling on either of handles 202 or 212, the switch 56 may be manually actuated to raise, lower or stop the door at will. Also, it is obvious that any number of pull cords desired could be used, so that operating stations could be provided at various locations, as desired.

Attached to the inner end of shaft 166, within housing 58, is a radially extending finger 214. When the shaft is turned in a counter-clockwise direction as viewed in Fig. 4, said finger engages and moves a rod 216 which is parallel to shaft 166 and which is fixed to a disc 218 rotatably mounted on shaft 134. As best shown in Fig. 6, a dog 220 pivoted on said disc is urged by a leaf spring 222, also carried by said disc, into engagement with a 12-toothed ratchet wheel 224 which is fixed on shaft 134. Thus when shaft 166 is turned in a clockwise direction, considering Fig. 6, finger 214 moves finger 216 and turns disc 218, forcing dog to turn shaft 134 to advance switch cam 132. When shaft 166 is oscillated in the opposite direction, finger 214 does not return the dog to its starting position. It is returned to said starting position by a counterweight 226 (see Fig. 6) threaded on a screw 228 fixed to the periphery of disc 218 and extending radially therefrom, said weight being secured on said screw by nuts 230. The downward movement of the weight is limited by a pin 232, which engages and stops screw 228, and which is fixed to a portion of housing 58, such as partition wall 64. The engagement of tooth 188 in star wheel 186 also serves to prevent dog 220 from turning ratchet wheel 224 during its return stroke, and to position switch cam 132 precisely on one of its stations in the event shaft 166 is not turned precisely 30 degrees. Shaft 166 is turned by means of a crank 234 affixed to the outer end of said shaft. Said crank depends adjacent chain 32 as shown in Figs. 1, 3 and 4, and a pair of rivets 236 are fixed in said crank and extend horizontally therefrom, rollers 238 and 240 being rotatably mounted respectively on said rivets.

Roller 238 is positioned immediately above the upper reach of chain 32, and roller 240 is positioned directly above the lower reach of the chain. Roller 238 is adapted to be engaged and moved, whereby to pivot crank 234, by a projecting finger 242 affixed to the upper chain reach, and roller 240 is adapted to be engaged by a projecting finger 244 affixed to the lower chain reach. The vertical length of fingers 242 and 244 is such that as they pass under rollers 238 and 240, they will each pivot crank 234 through the same angle, which of course should be 30 degrees or slightly more.

The operation of the device is substantially as follows. Assuming first that all parts are positioned as shown in the drawing, with door 6 closed, the door is caused to open by pulling momentarily on either of the handles 202 or 212 of the pull cords. This pivots switch crank 194 against the pressure of spring 182, and acts through internal switch arm 168, rod 170, arm 172, dog 174, ratchet wheel 178 and shaft 134 to turn switch cam 132 one station in a counter-clockwise direction as viewed in Fig. 5. The cam follower 150 is thus positioned in cam notch 158, and switch arm 78 is thus tilted to close the switch to actuate motor 42 to raise the door. During the opening movement of the door, the lower reach of chain 32 of course travels to the right as viewed in Fig. 1, and during the initial portion of this movement the finger 244 carried by said chain contacts roller 240 of crank 234, and pivots it in a clockwise direction as viewed in Fig. 1. However, as seen in Fig. 4, this merely moves internal switch finger 214 away from rod 216. Thus finger 244 merely rides under roller 240 without actuating the switch, and crank 234 returns to a vertical position by gravity.

However, when the door is nearly open, finger 242 on the upper chain reach engages roller 238 and pivots crank 234 in a counter-clockwise direction as viewed in Fig. 1. This operates through internal switch finger 214, rod 216, disc 218, dog 220, ratchet wheel 224 and shaft 134 to turn cam 132 to its next station. Cam follower 150 is thus positioned in one of cam notches 160, and switch arm 78 is positioned as in Fig. 5 to open the switch and shut off the motor. The door may then be lowered or closed by pulling momentarily on handle 202 or 212. This functions as previously described to turn cam 132 to engage one of flats 156 thereof with follower 150, thereby tilting switch arm 78 to energize motor 42 to lower the door. During the initial portion of this movement chain finger 242 rides inoperatively under roller 238, but as the door approaches its closed position finger 244 engages roller 240 and pivots crank 234, whereby to turn cam 132 to bring a notch 160 thereof under follower 150, thereby shutting the motor off. Preferably the motor is shut off just before the door is completely closed, and the door "coasts" the remainder of the distance as the motor slows. Due to this "coasting," chain fingers 242 and 244 will move slightly farther than the operative positions of the rollers 238 and 240 respectively, and crank 234 will return to a vertical position by gravity. However, this is not esential.

The operation of the switch as a limit switch by crank 234 does not interfere at any time with manual operation thereof by crank 194. The door may be stopped at any time during either opening or closing movement thereof by a single pull on handles 202 or 212, since the next subsequent station of cam 132 is always a "switch off" position. After it is stopped, the door may be reversed by a single additional pull on either handle, or continued in the same direction by three pulls on either handle. Also, it will be seen that if an operator pulls handles 202 or 212 far enough to actuate the switch, but not far enough to advance shaft 134 a full tooth of ratchet wheel 178, so that dog 174 cannot engage the next tooth of the ratchet on its return stroke, the error will

be corrected by operation of crank 234 so that shaft 134 will turn ratchet 174 fully to its next position. Otherwise, an attempt to stop the door by pulling on cord 198 might be unsuccessful due to inoperability of dog 174. Errors of this type also tend to be corrected by the operation of tooth 188 on star wheel 186, as previously described.

While I have shown and described a specific embodiment of my invention, it will be apparent that many minor changes of structure and operation could be made without departing from the spirit of the invention as defined by the scope of the appended claims.

What I claim as new and desire to protect by Letters Patent is:

1. An electric switch having continuously consecutive positions in which it closes a first circuit, opens, closes a second circuit, opens, etc., and independently operable first and second switch operating means, each of said operating means being operable whenever actuated to advance said switch one position, said switch including a pivoted switch arm having a neutral open position and being operable when pivoted in opposite directions from said neutral position to close said first and second circuits respectively, a cam follower carried by said switch arm, and a generally polygonal cam rotatable about a central axis parallel to the axis of said switch arm, said follower engaging said cam midway between an apex thereof and the midpoint of an edge thereof when said switch is in its open position, and wherein each of said switch operating means is operable on each actuation to turn said cam through an angular distance equal to one-quarter of the arc subtended by each edge of said cam.

2. An electric switch as recited in claim 1 wherein said cam is generally triangular, and wherein each of said switch operating means is operable on each actuation to turn said cam through an angular distance of substantially 30 degrees.

3. An electric switch as recited in claim 1 wherein said cam is provided at each of its stations with a notch operable to be engaged by said follower to secure said cam releasably at any one of its stations.

4. In an electric switch as recited in claim 1, a rotatable shaft on which said cam is fixed, a star wheel also fixed on said shaft, said wheel having rounded notches formed in the periphery thereof corresponding in number and angular spacing to the stations of said cam, and being accurately indexed with respect thereto, and a spring-loaded tooth engaging the periphery of said wheel and operable as a yieldable detent securing said cam releasably at any of its stations.

5. An electric switch as recited in claim 1 wherein said cam is fixed on a rotatable shaft, and wherein each of said switch operating means constitutes a crank oscillatable with respect to said shaft, each of said cranks having a ratchet connection with said shaft whereby it will turn said shaft when pivoted in one direction, but not when pivoted in the opposite direction.

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