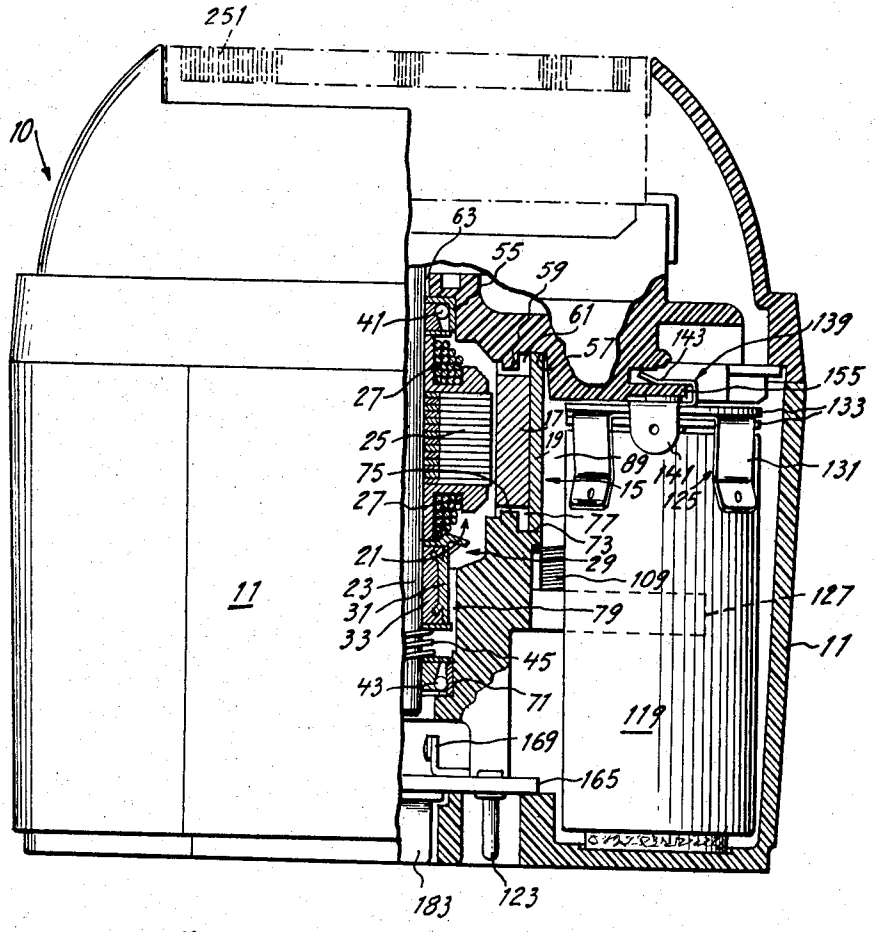
March 5, 1968 D. R. LOCKE ETAL 3,372,247

ELECTRIC SWITCH HAVING A PAIR OF CONTACTS ACTUATED BY A CAM MEANS HAVING A PLURALITY OF FLAT OUTER SURFACES

Original Filed Jan. 12, 1962

3 Sheets-Sheet 1

FIG. 1



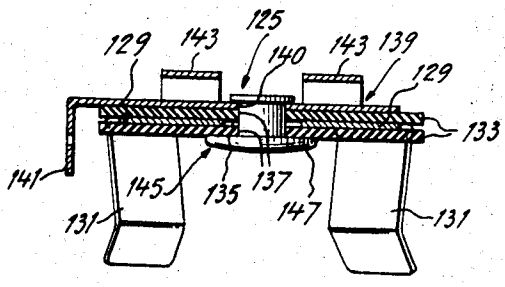


FIG. 5

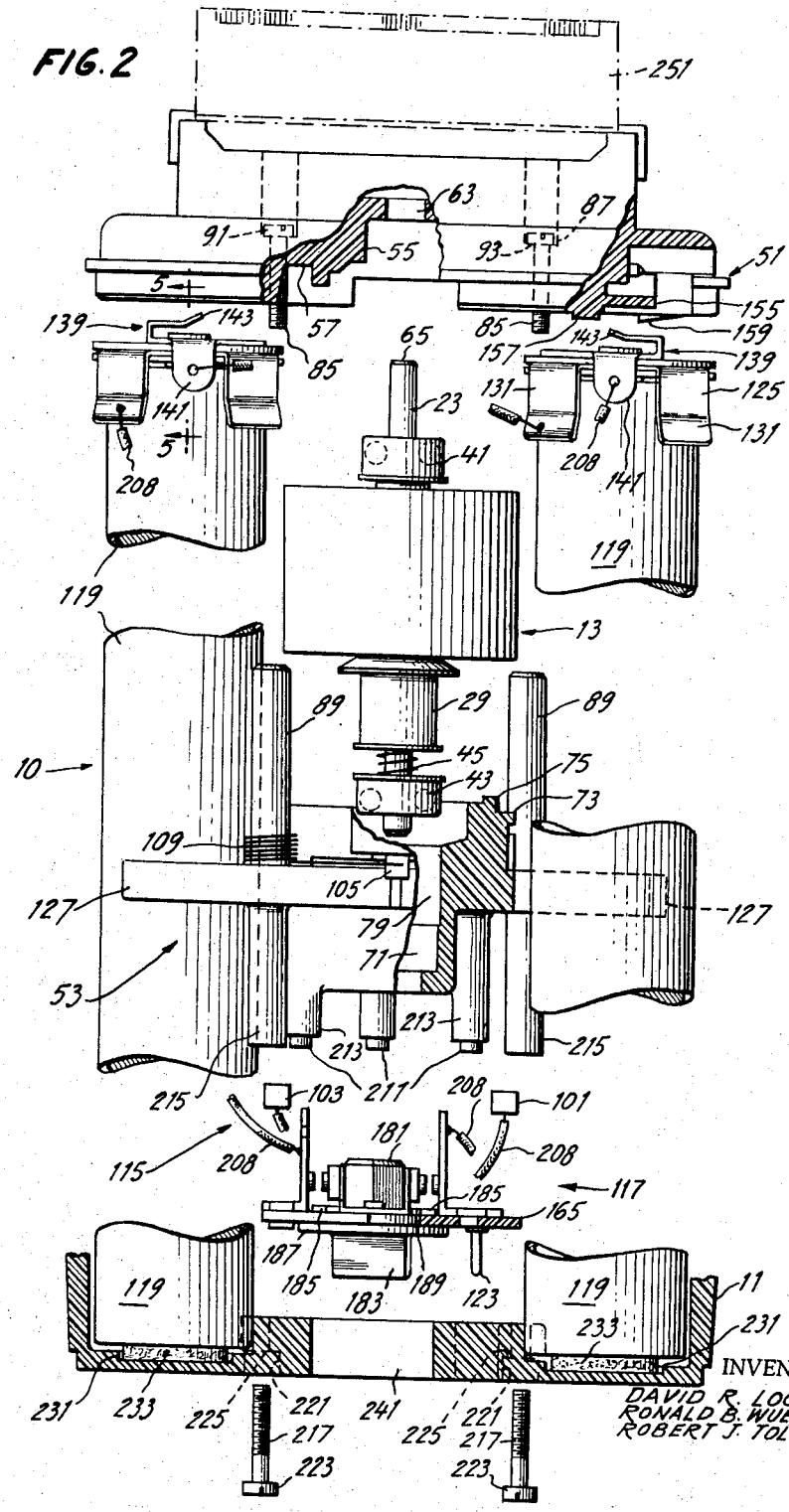
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FIG. 2



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Original Filed Jan. 12, 1962 3 Sheets-Sheet 3

FIG. 4

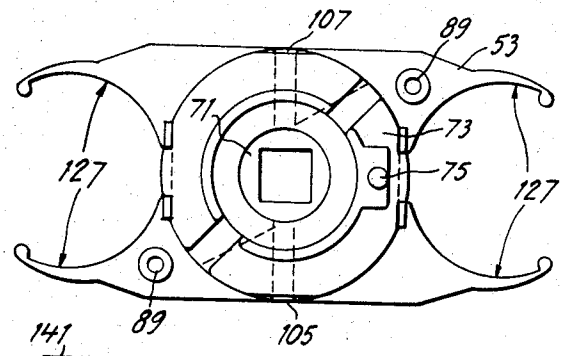


FIG. 3

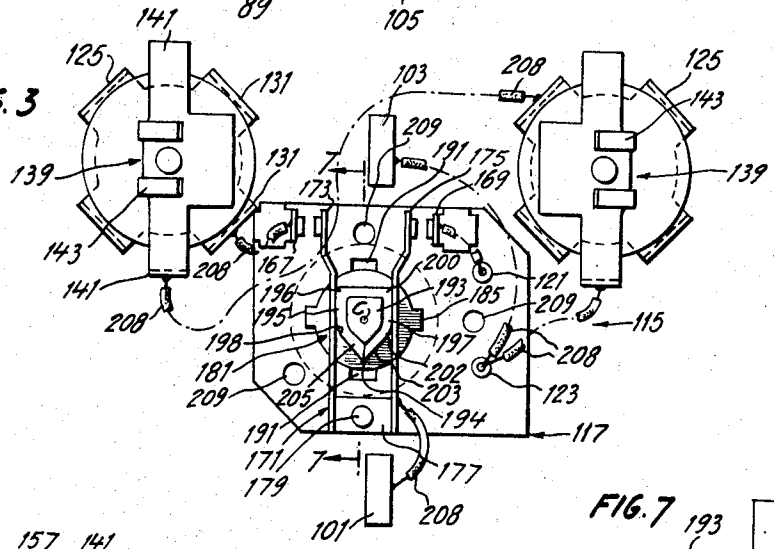
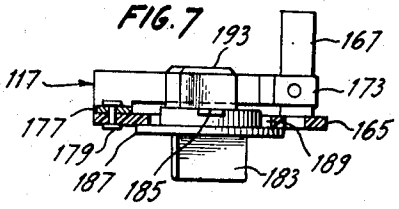


FIG. 7



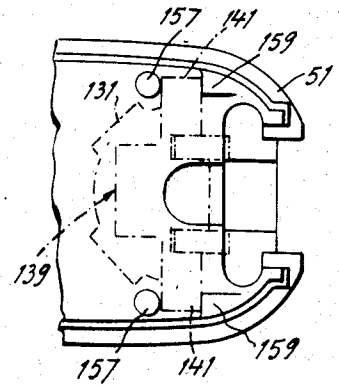


FIG. 6

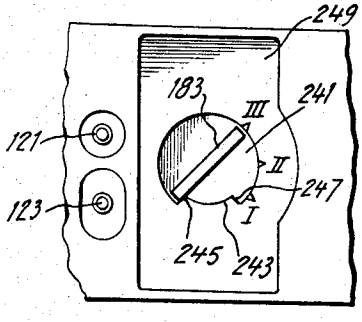


FIG. 8

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United States Patent Office

3,372,247

Patented Mar. 5, 1968

3,372,247

ELECTRIC SWITCH HAVING A PAIR OF CONTACTS ACTUATED BY A CAM MEANS HAVING A PLURALITY OF FLAT OUTER SURFACES

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Original application Jan. 12, 1962, Ser. No. 165,819, now Patent No. 3,255,435, dated June 7, 1966. Divided and this application Oct. 21, 1965, Ser. No. 513,887

2 Claims. (Cl. 200—6)

ABSTRACT OF THE DISCLOSURE

This disclosure is directed to an electric switch comprising a pair of spaced movable leaf spring contacts each adapted for engagement with a corresponding spaced stationary contact wherein an actuator member is provided with cam means disposed between said movable contacts for controlling movement thereof and having a plurality of spaced flat outer surfaces adapted to coact with said movable contacts to be detented by the latter in any moved position.

This invention relates to an electric switch for a portable motor operated electrical appliance and is a division of application Ser. No. 165,819, filed Jan. 12, 1962 and now U.S. Patent No. 3,255,435.

Portable motor operated electrical appliances and power tools which have a self-contained power source inherently must possess the characteristic of compactness in order to be of maximum use to the purchaser or user. Compactness of a product generally results in manifold problems of manufacture and assembly which in turn are reflected in the price and/or the servicing of the product. Since portable appliances and tools of this type are sold to the public generally rather than only to a restricted group or class, such as industrial users, price and service become major considerations to the manufacturer of such products.

An object of this invention is to provide a novel multiposition electric switch unit having a movable contact and a selectively positionable contact actuator with the movable contact and contact actuator also coacting as a detent to prevent undesired movement of the contact actuator.

Other objects and advantages of the invention, in its details of construction and arrangement of parts, will be apparent from a consideration of the following specification and accompanying drawings wherein:

FIG. 1 is an elevational view of a motor operated electrical appliance with a portion thereof in section and which appliance embodies the present invention;

FIG. 2 is an exploded, elevational view of the device shown in FIG. 1;

FIG. 3 is a plan view of the electrical assembly;

FIG. 4 is a plan view of the upper surface of the lower end-bell;

FIG. 5 is an elevational view in partial section of the battery holder assembly;

FIG. 6 is a sectional plan view of the end of an upper end-bell showing the battery holder assembly positioned thereon;

FIG. 7 is a sectional view of the switch taken along lines 7—7 of FIG. 3; and

FIG. 8 is a partial view of the bottom of the assembled device.

Referring now to the drawings for a more detailed description of the present invention an embodiment thereof is incorporated in an electric dry shaver generally designated by the numeral 10. It should be understood however, that the hereinafter described application of the invention to an electric shaver is for purposes of illustration only inasmuch as the subject invention finds ready application to many different electrical appliances or power tools which are motor operated. A casing 11 of electric shaver 10 houses a low voltage DC motor assembly 13. The motor assembly 13 may be of any suitable type as long as it conforms to the power requirements and size restrictions of the particular appliance or power tool.

In the preferred embodiment the motor assembly 13 utilizes a cylindrical stator 15 (FIG. 1) which comprises an inner cylindrical field member 17 and an outer split ring 19, interconnected by a key and slot (not shown) to prevent relative rotation. An armature 21 has a shaft 23 upon which is mounted a laminated body 25 with coil windings 27. The coil windings 27 are electrically connected to a commutator 29 formed of a plural electrically insulated conductive segments 31 set in a molded plastic body 33.

The motor assembly 13 is mounted for rotation in upper bearing assembly 41 and lower bearing assembly 43. A spring 45 is mounted on armature shaft 23 between commutator 29 and lower bearing assembly 43 to bias the shaft in the direction of bearing assembly 41.

The motor assembly 13 and bearing assemblies 41 and 43 are seated in an upper end-bell 51 and a lower end-bell 53. The upper end-bell 51 has integrally formed therein a bearing seat 55 and a stator seat 57. The stator seat 57 is further provided with a key 59 adapted for seating in a slot 61 of tubular stator 15 to prevent rotational movement of the tubular stator 15 with respect to the end-bells 51 and 53. The upper end-bell 51 also has an aperture 63 for receiving the end 65 of armature shaft 23.

The lower end-bell has integrally formed therein a bearing seat 71, and a stator seat 73. The stator seat 73 is further provided with a key 75 adapted for seating in a slot 77 of tubular stator 15 to prevent rotational movement of the tubular stator 15 with respect to the end-bells 51 and 53. The lower end-bell 53 is provided with a commutator recess 79.

Upper end-bell 51 and lower end-bell 53 are secured together by two threaded members 85 (FIGS. 1 and 2) which are accommodated within apertures 87 (FIG. 2) formed in the upper end-bell 51. The threaded portions of members 85 are threaded into posts 89, integrally formed on the lower end-bell 53, until a head 91 of the threaded member 85 abuts against a shoulder 93 formed in the upper end-bell 51. Posts 89 also serve to space the upper end-bell 51 from the lower end-bell 53 when assembled. The posts 89 may either be internally threaded or provided with apertures having smooth walls whereby

the threaded members are of the self tapping variety. The upper end-bell 51 and lower end-bell 53 are preferably formed of a material having nonmagnetic and nonconductive properties such as plastic.

The motor assembly 13 receives its electrical energy through brushes 101 and 103 (FIG. 3) which engage commutator 29 and are slidably disposed in passageways 105 and 107 (FIG. 4) in lower end-bell 53. Springs 109 (FIGS. 1 and 2) are mounted on the posts 89 of the lower end-bell 53 and bias the brushes 101 and 103 into engagement with the commutator 29.

Brushes 101 and 103 are part of an electrical assembly 115. The electrical assembly 115 provides a switch 117 for selectively interconnecting the brushes 101 and 103 to either a self-contained source of power as for example batteries 119 or to an external DC source through terminals 121 and 123.

The batteries 119 are held in place by battery holder assemblies 125 and resilient arms 127 integrally formed on the lower end-bell 53. The battery holder assembly 125 serves the dual function of positioning the battery and making contact with the battery terminals. To accomplish this a battery holder 129 (FIG. 5) of electrically conductive material has formed thereon prongs 131 adapted to firmly grasp a battery therebetween. An aperture 135 is formed in the battery holder and positioned above and below the latter are two insulators 133. The two insulators 133 are provided with center apertures 137 which are of smaller diameter than the aperture 135 formed in the center of the battery holder 129.

A terminal clip 139 having terminal portions 141 and spring clip portions 143 is positioned above the insulators 133 and battery holder 129. The terminal clip 139 has an aperture 140 formed therein. A rivet 145 with its head 147 positioned below the lower insulator 133, is inserted into the apertures 135, 137 and 140 with the center of the rivet 145 and apertures 135, 137 and 140 aligned. The small diameter of the apertures 137 in the insulators 133 will space the rivet 145 from the battery holder 129. The rivet is peened over against terminal clip 139 interconnecting the rivet 145, battery holder 129, insulators 133 and terminal clip 139 to provide a secure assembly.

The battery holder assembly 125 is constructed to be used with a battery 119 of the cylindrical type. The battery has a cap on the top thereof serving as one terminal. The sides of the battery serve as the second terminal. When seated in the battery holder assembly 125 the cap of the battery contacts the rivet 145 and the sides of the battery are in contact with prongs 131.

A ledge 155 and retaining lugs 157, 159 (FIGS. 2 and 6) are integrally formed on upper end-bell 51 and serve to position the battery holder assembly 125. The retaining lugs are spaced apart a distance equal to the longitudinal dimension of terminal portion 141 (as seen in FIG. 6) of the terminal clip 139. Retaining lugs 159 are cam or wedge shaped (FIG. 2) to spread the spring portion 143 of the terminal clip 139 to facilitate attachment of the battery holder assembly 125 to the upper end-bell 51.

The terminals 121, 123 are mounted on a terminal board 165 of an electrically non-conductive material. Also mounted on terminal board 165 are stationary contacts 167, 169 (FIG. 3) and a movable contact 171. The movable contact 171 has two spaced leaf spring contact arms 173, 175 interconnected at one end by a conductive member 177 and conductive member 177 is secured to the terminal board 165 by a rivet 179, or any other suitable securing means. The movable contact arms 173, 175 by their construction are biased towards each other.

A contact actuator 181 (FIGS. 2 and 3) is rotatably carried by the terminal board 165 and is positioned between the two leaf spring contact arms 173, 175 to space same and to engage either of said leaf spring contact arms 173, 175 with their respective stationary contacts 167, 169, respectively. The contact actuator 181 has integrally formed therewith a flat piece 183 (FIGS. 1 and 7) which may be manually grasped and turned to rotate contact actuator 181. Actuator 181 has lip members 185 and a flange 187 (FIGS. 3 and 7) formed thereon. The terminal board 165 has an aperture 189 and slots 191 formed therein. With the lip member 185 aligned with the slots 191 the actuator 181 may be inserted up from the bottom of the terminal board 165 until the flange 187 abuts against the bottom of the terminal board 165. A slight rotation will place the lip members 185 on the top surface of the terminal board 165. The lip members 185 and flange 187 coacting with the terminal board 165 will constrain the contact actuator 181 to rotational movement with respect to the terminal board 165.

A cam 193 (FIG. 3) is formed on the upper portion of contact actuator 181 and has a pentagonal configuration which may be considered to include a rectangle and a triangle with a side of the rectangle common with the base of the triangle. An apex 194 of the triangle portion of cam 193 is adjacent securing element 179 when contact actuator 181 is properly set to its center position (FIG. 3) on terminal board 165. In this center position sides 195 and 197 of the rectangular portion of cam 193 are engaged by leaf spring contact arms 173 and 175, respectively. The coaction between the leaf spring contact arms 173 and 175 and sides 195 and 197 detents the cam 193 and thereby contact actuator 181 in the center position (FIG. 3).

Corners 196 and 198 of the rectangular portion of cam 193 engage leaf spring contact arm 173. Corners 200 and 202 of the rectangular portion of cam 193 engage leaf spring contact arm 175. The radial distance of corners 196 and 200 from the center of rotation *c* of cam 193 is greater than the radial distance of corners 198 and 202 from the center of rotation *c* of cam 193.

When the contact actuator 181 is rotated counterclockwise from the center position, as seen in FIG. 3, corner 196 will move leaf spring contact arm 173 towards stationary contact 167 and corner 202 will move leaf spring contact arm 175 towards stationary contact 169. The radial distance of corner 196 from the center of rotation *c* of cam 193 is sufficient to move leaf spring contact 173 into engagement with stationary contact 167. However, the radial distance of corner 202 from the center of rotation *c* of cam 193 is insufficient to move leaf spring contact 175 into engagement with stationary contact 169. When contact actuator 181 has been rotated (counterclockwise) a sufficient distance, a leg 203 of the triangular portion of cam 193 will be engaged by leaf spring contact arm 175 to detent the contact actuator 181 in its counterclockwise position.

When the contact actuator 181 is rotated clockwise from the center position, as seen in FIG. 3, corner 200 will move leaf spring contact arm 175 towards stationary contact 169 and corner 198 will move leaf spring contact arm 173 towards stationary contact 167. The radial distance of corner 200 from the center of rotation *c* of cam 193 is sufficient to move leaf spring contact 175 into engagement with stationary contact 169. However, the radial distance of corner 198 from the center of rotation *c* of cam 193 is insufficient to move leaf spring contact 173 into engagement with stationary contact 167. When contact actuator 181 has been rotated (clockwise) a sufficient distance, a leg 205 of the triangular portion of cam 193 will be engaged by leaf spring contact arm 173 to detent the contact actuator 181 in its clockwise position.

The brushes 101, 103 battery holder assemblies 125, terminals 121, 123, stationary contacts 167, 169 and movable contact 171 are all electrically interconnected by conductive members 208 so that rotation of the contact ac-

tuator **181** from its center position in one direction will complete a circuit from the battery holders assemblies **125** to the brushes **101, 103** and the rotation of the contact actuator **181** from its center position in the other direction will complete a circuit from the terminals **121, 123** to the brushes **101, 103**. If desired, provision may be made for a recharging circuit for the batteries **119**.

The terminal board **165** has three apertures **209** formed thereon. The diameter of the apertures **209** is chosen to provide a friction fit between the sides of the apertures **209** and three lugs **211** on the ends of posts **213** of the lower end-bell **53**.

Also provided on the lower end-bell **53** are two posts **215**. The ends of posts **215** are hollow and receive threaded members **217**. The ends of posts **215** may be threaded or not, but if not threaded self-tapping threaded members are used.

The structure described up to this point is accommodated within casing **11** which has formed therein openings **221** through which the threaded portion of threaded members **217** pass when screwed into posts **215**. When the heads **223** of threaded members **217** abut against shoulders **225** on the bottom **219** of casing **11** will be securely positioned to house all the assembled components of the device.

Casing **11** has formed therein recesses **231** which position pads **233** attached to the lower ends of batteries **119**. The pads **233** are made from a nonconductive resilient substance such as foam rubber. Also formed in the bottom of casing **219** is an aperture **241** (FIGS. 2 and 8) through which flat piece **183** of the contact actuator **181** extends when the device is assembled. A lug **243** is formed on the inner surface of the aperture **241** and includes a pair of shoulders **245, 247** which coact with piece **183** to restrict rotational movement of the contact actuator **181**.

A plate **249** is attached to the bottom of the casing by suitable means. The plate **249** has markings thereon to indicate the positions of switch **117**. If preferred the markings may be made directly on the surface of casing **219**.

Position II corresponds to the center position of contact actuator **181** (FIG. 3), while positions I and III correspond respectively to the counterclockwise and clockwise positions of contact actuator **181** as hereinbefore described with respect to FIG. 3.

To assemble the device the bearing assembly **43** is positioned in its seat **71** on the lower end-belt **53**. With spring **45** in place on the armature shaft **23** the motor assembly **13** is placed on the lower end-bell **53**. The tubular stator **15** is easily positioned in its seat **73**. A slight rotation of the tubular stator **15** may be required to align the key **75** on the lower end-bell **53** with the slot **77** in the tubular stator **15**. Springs **109** are placed on posts **89**. The bearing assembly **41** is next seated in its seat **55** in the upper end-bell **51** and the upper end-bell **51** is secured to the lower end-bell **53** by use of the two threaded members **85**.

The electrical assembly **115**, preassembled as a unit, is attached to the upper end-bell **51** by snapping the terminal clips **139** over ledges **155**. The retaining lugs **157, 159** positioning the terminal portion **141** therebetween. The terminal board **165** is then snapped onto the posts **213** on the lower end-bell **53**. Brushes **101** and **103** are inserted into passageways **105, 107** the springs **109** set to bias the brushes **101, 103** into engagement with the commutator **29**.

Each battery **119** is inserted into its battery holder assembly **125** and between the resilient arms **127** on the lower end-bell **53**. If the battery **119** should be incorrectly inserted, the pad **233** on the bottom thereof will engage the rivet **147** and thereby provide an open circuit which will prevent damage to the device.

Casing **11** is positioned over the components and secured to posts **215** on the lower end-bell **53** by the use of threaded members **217**.

The cutter shaver head **251** is next attached to the upper end-bell **51** and the end **65** of the armature shaft **23**. The upper end-bell **51** has the proper structure to accommodate the shaver head. If servicing is required, the casing **11** is removed and the entire operating mechanism is still properly positioned and operable without the casing. This facilitates observation of the various parts while the device is running.

The batteries **119** may be quickly removed and replaced without breaking any solder joints or unscrewing any terminals.

The entire electrical assembly **115** may be removed if required by merely extracting the brushes **101, 103** and removing the battery holder assemblies **125** and terminal board **165**.

It is now apparent that the present invention provides a unique assemblage which renders possible easy assembly and disassembly without sacrificing compactness and without a multi-part complicated mounting structure.

It is understood that although we have shown the preferred form of our invention, that various modifications may be made in the details thereof without departing from its spirit as comprehended by the following claims.

We claim:

1. An electric switch of the class described, comprising:

(a) a support member of nonconductive material,

(b) a pair of spaced stationary contacts secured to said support member,

(c) contact actuator means rotatably mounted on said support member and comprising a handle portion at one side of said support member and a cam portion positioned on the other side of said support member,

(d) a pair of spaced movable leaf spring contacts carried by said support member and having portions biased into engagement with said cam portion,

(e) said movable leaf spring contacts each having a free end positioned in the space between said stationary contacts and adapted for movement into engagement with an adjacent one of said stationary contacts with the other ends of said leaf spring contacts being electrically interconnected and secured to said support member,

(f) said cam portion operable upon rotation of said handle portion from a first position where both movable contacts are out of engagement with said stationary contacts to a second position to move one of said movable contacts into engagement with its adjacent stationary contact and to a third position to disengage the latter contacts and move the other movable contact into engagement with the remaining stationary contact,

(g) said cam portion in cross section appearing as a rectangular figure and a triangular figure with the base of the triangle on one side of the rectangle forming a common line,

(h) the two sides of the rectangle perpendicular to said common line being engaged by the movable leaf spring contacts to detent the cam portion in said first position, and

(i) one leg of the triangle being engaged by the adjacent movable leaf spring contact to detent the cam portion in said second position and the opposite leg of said triangle being engaged and detented by the other movable contact when said cam portion is in said third position.

2. The electric switch of claim **1** wherein:

(a) the free ends of the movable leaf spring contacts are normally spaced from the stationary contacts a predetermined distance,

(b) the rectangle has a base portion parallel to the common line and intersecting the side portions at a point,

(c) said point engaging a movable leaf spring contact and being located at a distance from the rotative

center of said cam portion a sufficient distance to move the free end of said movable leaf spring contact into engagement with a stationary contact,

(d) the leg of the triangle opposite said point engaging the other movable leaf spring contact to detent said contact moving means, said leg having a perpendicular distance from the rotative axis of the cam portion which is insufficient to move the free end of the movable leaf spring contact into engagement with the stationary contact.

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