United States Patent [19]

Sahrbacker

[11] **3,713,070**

[45] **Jan. 23, 1973**

[54] **ROTARY ACTUATOR FOR A SWITCH**

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[73] Assignee: **Lucerne Products, Inc.,** Hudson, Ohio

[22] Filed: **May 3, 1971**

[21] Appl. No.: **139,384**

[52] **U.S. Cl.** .....**338/198,** 338/179, 200/153 P, 200/157, 200/158

[51] **Int. Cl.** **H01c 9/08**

[58] **Field of Search**.....338/198, 200, 201, 179, 172, 338/173; 200/153 P, 157, 158; 318/345

[56] **References Cited**

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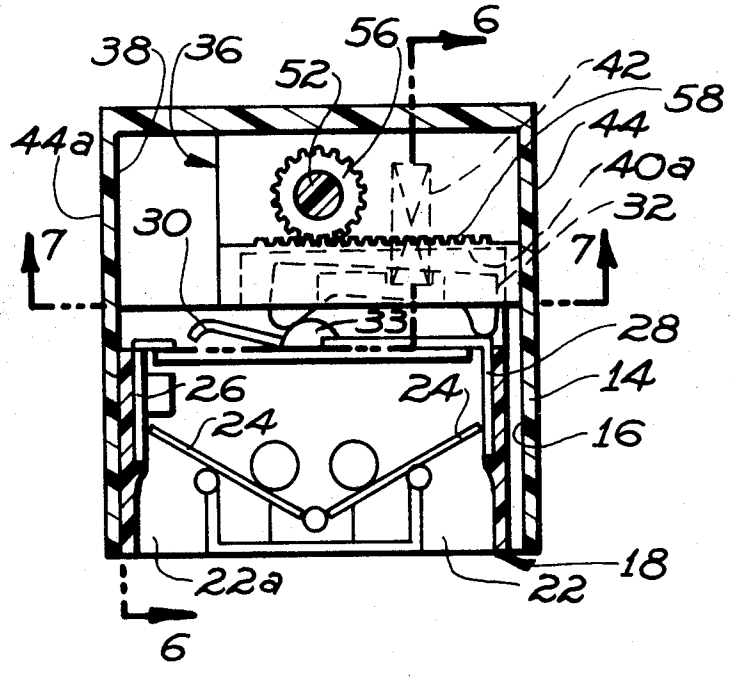
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Primary Examiner—Bernard A. Gilheany
Assistant Examiner—D. A. Tone
Attorney—Baldwin, Egan, Walling & Fetzer

[57] **ABSTRACT**

A rotatable actuator means for an electric switch in which the switch includes spaced stationary contact means and bridging contact means for movement into electrical conducting relation with respect to the spaced stationary contact means. The switch may include rheostat means disposed in circuit with the stationary contact means for speed control, with the rheostat means being selectively movable with the bridging contact means by the rotary actuator means, for providing a plurality of resistance values as determined by the position of the rotatable actuator means.

18 Claims, 15 Drawing Figures



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SHEET 1 OF 2

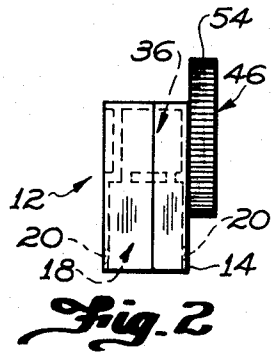


Fig. 2

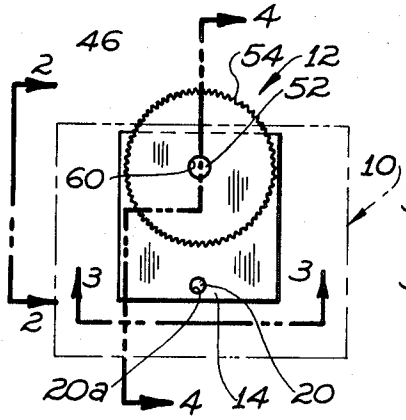


Fig. 1

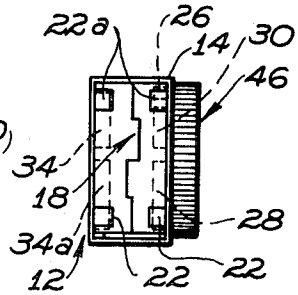


Fig. 3

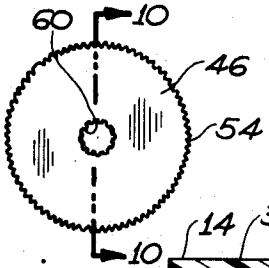


Fig. 9

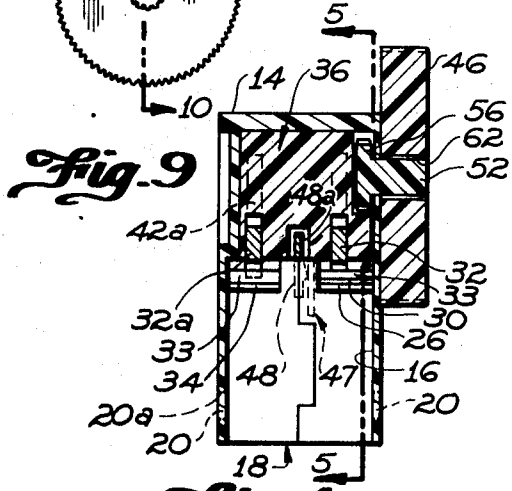


Fig. 4

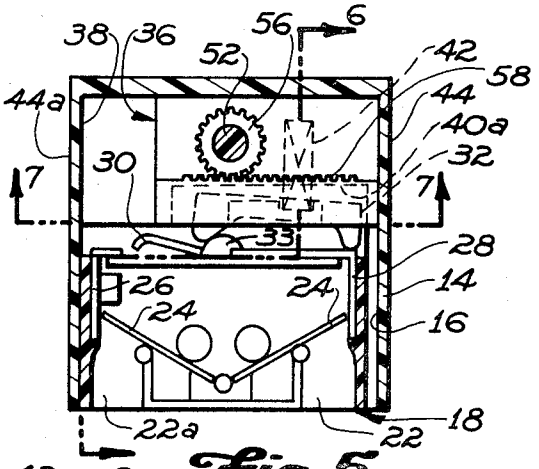


Fig. 5

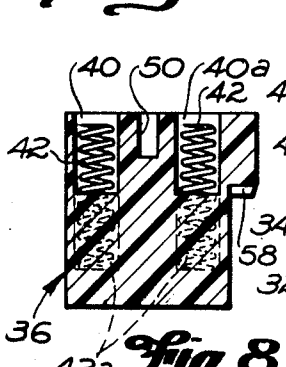


Fig. 8

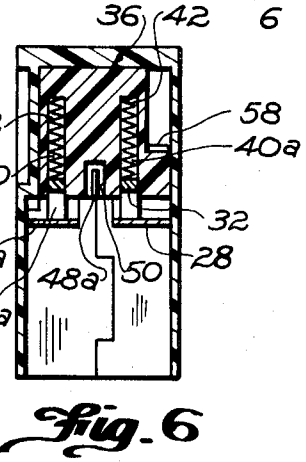


Fig. 6

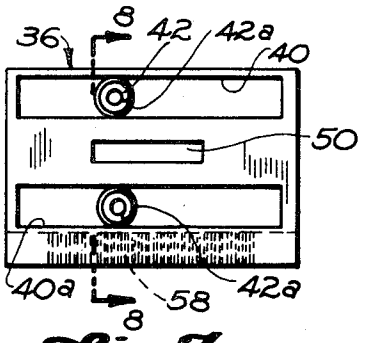


Fig. 7

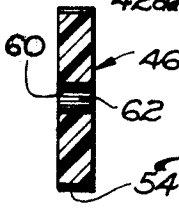


Fig. 10

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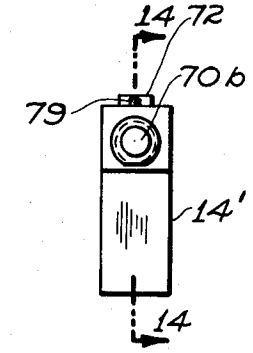


Fig. 12

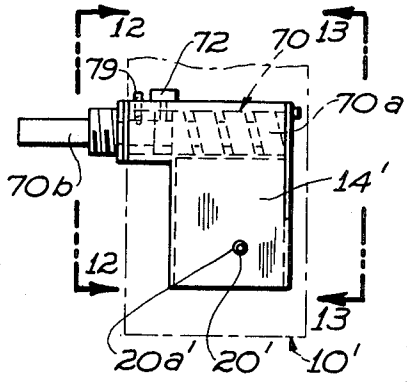


Fig. 11

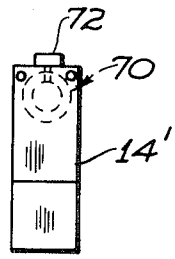


Fig. 13

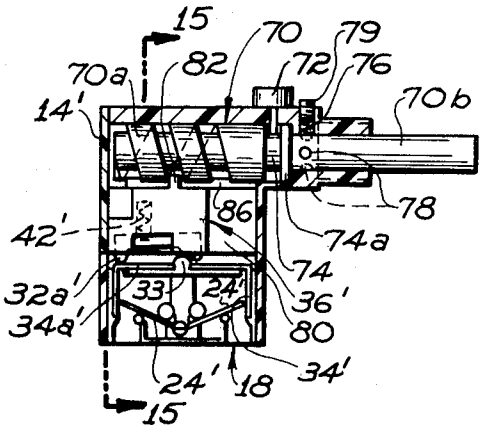


Fig. 14

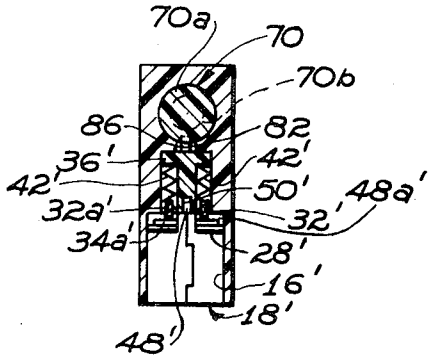


Fig. 15

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ROTARY ACTUATOR FOR A SWITCH

This application relates in general to a compact electrical switch for controlling the operation of an electrically powered device, such as for instance, a motor, and more particularly to a compact electrical switch having rotatable actuating means for actuating and deactuating the switch mechanism.

BACKGROUND OF THE INVENTION

There are numerous switch known in the prior art for controlling power actuated devices such as for instance, an electric motor of a hand operated power tool. Some of such switches are adapted to control the speed of the motor of the tool as well as control the actuation and deactuation of the motor.

In U.S. Pat. Nos. 3,389,365 and 3,536,973 issued respectively on June 18, 1968 and Oct. 27, 1970 to Benjamin H. Matthews et al., there are disclosed electrical control switches of the type comprising bridging contact means slidable or movable with respect to spaced stationary contact means of the switch and between a nonbridging position and a bridging position and vice versa, for connecting and disconnecting a source of electrical energy to a circuit input, and including another assembly having rheostat means with slidably actuated rheostat element for regulating the magnitude of electrical energy input to the circuit input, and with the rheostat element and the bridging contact means being actuated by means of a lineraly movable trigger actuator mechanism.

SUMMARY OF THE INVENTION

The present invention provides an electrical switch having an actuator mechanism including a rotary member, and wherein the switch includes bridging contact means mounted on a carrier member which coacts with the rotatable member in a manner causing generally linear movement of the carrier during rotary movement of the rotary member, for moving the bridging contact means relative to stationary contact means. The switch may include associated rheostat means mechanically coupled to the carrier for movement generally linearly with the carrier during rotary movement of the rotary member, to provide speed control, and in an expeditious, highly compact arrangement.

Accordingly, an object of the invention is to provide a novel electrical control switch.

Another object of the invention is to provide a novel electrical control switch which can be expeditiously manufactured and assembled and results in a switch for smoothly and effectively controlling the speed of an electric motor.

Another object of the invention is to provide a rotary type of electrical control switch of the variable speed type and wherein the rotary actuator for the switch is operatively coupled to a carrier member supporting bridging contact means for movement between a nonbridging position and a bridging position and vice versa, for connecting and disconnecting a source of electrical energy to a circuit input, and wherein the carrier member also coacts with a rheostat element for moving the rheostat element linearly relative to the rheostat for adjusting and regulating the magnitude of electrical energy input to the circuit.

A still further object of the invention is to provide a control switch of the above discussed type wherein the bridging contact means is provided in both lines of the conductors from the source of electrical energy to the electric motor rather than in only one line thereof, and wherein actuation of the rotary actuating means causes the bridging contact member means in both lines to move from a bridging position to a nonbridging position and vice versa.

Other objects and advantages of the invention will be apparent from the following description taken in conjunction with the accompanying drawings wherein:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an elevational view of a switch embodying the present invention; in dot-dash lines the switch is shown mounted on a support which may include an electrically powered mechanism (not shown) such as for instance, an electric motor for a small hand operated power tool;

FIG. 2 is an elevational view of the switch taken generally along the plane of line 2—2 of FIG. 1 looking in the direction of the arrows;

FIG. 3 is a bottom plan view taken generally along the plane of line 3—3 of FIG. 1 looking in the direction of the arrows and illustrating the bottom of the variable speed control switch case mounted in the wrap around switch housing;

FIG. 4 is an enlarged, sectional view taken generally along the plane of line 4—4 of FIG. 1 looking in the direction of the arrows, and illustrating the coupling of the rotary actuator to the carrier for the bridging contacts of the switch mechanism, and the coupling of the rheostat contactor to the carrier;

FIG. 5 is a sectional view taken generally along the plane of line 5—5 of FIG. 4 looking in the direction of the arrows, and showing a bridging contact in a nonbridging or off position;

FIG. 6 is a sectional view taken generally along the plane of line 6—6 of FIG. 5 looking in the direction of the arrows and illustrating the spaced bridging contacts which are adapted for coaction with a respective set of spaced stationary contacts, for disposal in both lines of the conductors from the source of electrical energy to an electrically powered mechanism;

FIG. 7 is an enlarged, bottom plan view of the carrier member which is adapted to mount the bridging contacts of the switch mechanism;

FIG. 8 is a sectional view taken generally along the plane of line 8—8 of FIG. 7 looking in the direction of the arrows;

FIG. 9 is a side elevational view of the rotary wheel knob for actuating and deactuating the switch;

FIG. 10 is a sectional view of the wheel knob;

FIG. 11 is a side elevational view of a modified embodiment of rotary speed control switch;

FIG. 12 is an elevational view taken generally along the plane of line 12—12 of FIG. 11 looking in the direction of the arrows;

FIG. 13 is an elevational view taken generally along the plane of line 13—13 of FIG. 11 looking in the direction of the arrows;

FIG. 14 is an enlarged sectional view taken generally along the plane of line 14—14 of FIG. 12 looking in the direction of the arrows, and illustrating the coaction

between the rotary worm actuator of the switch mechanism and the carrier member which mounts the bridging contacts of the switch mechanism thereon;

FIG. 15 is a sectional view taken generally along the plane of line 15—15 of FIG. 14 looking in the direction of the arrows, and showing the mounting of the bridging contacts of the switch mechanism and the carrier member, and the coaction between the rheostat tab and the carrier member, for simultaneous lengthwise movement of the bridging contact means and the rheostat contactor element during rotation of the rotary actuator means.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now again to the drawings, there is illustrated in FIG. 1 a support 10 which may represent an electrically powered hand tool or the like mounting a rotatable speed control switch 12 thereon. Switch 12 comprises a wrap-around housing 14 which may be conveniently formed from plastic or the like, and which housing 14 is open on the bottom thereof and defines therein a rectangular-shaped chamber 16 in which is adapted to be received a split or two section casing 18 containing certain components of the variable speed switch. Casing 18 may be readily formed from electrical insulating material such as plastic or the like, and has projections 20 (FIG. 1) on the sides thereof which are adapted to be received in snap-fastening relation in openings 20*a* in the confronting sides of the housing member 14, for detachably holding the speed control switch casing 18 and associated components in assembled relation with the wrap-around housing 14.

The underside of the speed control switch casing 18 may be provided with openings 22 therein, through which are adapted to extend bared wires, for coupling the switch assembly to the electric powered means, such as for instance an electric motor. Openings 22*a* may also be provided in the underside of the switch casing 18 adapted to receive bared wire leads for coupling the switch assembly to a suitable source of electrical power, and which leads may form part of the electric cord of for instance a tool assembly.

When the bared wires are inserted to the respective openings 22 or 22*a*, they are adapted to coact in gripped relationship by the flexible resilient grippers 24 mounted in the speed control casing 18 in the conventional manner, for holding the respective wire in electrical conducting relationship to a respective one of the stationary contacts 26, 28 mounted in the casing 18. The speed control switch components as illustrated may be generally similar to those described and shown in aforementioned U.S. Pat. No. 3,536,973.

Referring to FIG. 5, one group of three of the stationary contacts are shown, including stationary contact 30 and the aforementioned stationary contacts 26, 28. Such stationary contacts may correspond respectively to contacts 52*a*, 52*b* and 52 of aforementioned U.S. Pat. No. 3,536,973. The bridging contact 32 in FIG. 5 is shown cammed out of engagement with the intermediate contact 30 by cam abutment 33 and is disposed only in engagement with stationary contact 28, thus disconnecting the electrically actuated power means or motor from the source of power. Accordingly, the switch is in an off position in the position of the components shown in FIG. 5. The other bridging contact member 32*a* which can be best seen in FIGS. 4 and 6, is likewise in the general position of the bridging component 32 illustrated in FIG. 5, out of engagement with its lefthand (with reference to FIG. 5) stationary contact 34 and being disposed in engagement with its righthand (with reference to FIG. 5) stationary contact 34*a*. Contact 34 may correspond in general to stationary contact 48*a* while contact 34*a* may correspond to contact 48 of aforementioned U.S. Pat. No. 3,536,973.

Bridging contacts 32, 32*a* are mounted on carrier member 36 which is adapted to move generally linearly in elongated chamber 38 (FIG. 5) in the upper portion of the wrap-around housing 14. As can be best seen in FIGS. 5, 6 and 7, the carrier member 36 is provided with spaced elongated slots or recesses 40, 40*a* therein in which is disposed in movable relation a respective bridging contact 32*a*, 32, with resilient means such as for instance a coil spring 42, coacting with the respective bridging contact to urge the latter downwardly away from carrier 36 and into electrical conducting engagement with the underlying stationary contacts. Springs 42 may be received in wells 42*a* communicating with the respective recess 40, 40*a*. Carrier member 36 may be conveniently formed of plastic or some other electrical insulating material and is adapted to slide relatively easily in the upper chamber 38 in wrap-around housing 14, and from one end wall (e.g., 44 thereof) to the other end wall (e.g., 44*a*) thereof, upon actuation of the carrier member 36 by actuation of the rotatable actuator 46.

The speed control switch casing 18 may also house rheostat 47 (FIG. 4) having a slidable contactor member 48 provided with an upstanding tab 48*a* which is adapted to be received in a slot or recess 50 (FIGS. 4, 6 and 7) formed in the underside of carrier member 36. Upon linear movement of the carrier member 36 due to actuation of the rotary actuator 46, the rheostat contactor 48 is caused to move or slide generally linearly with movement of the carrier and associated bridging contacts 32, 32*a*.

Projecting laterally through one side of wrap-around housing 14 and rotatably mounted thereon, there may be provided a stub axle 52 (FIG. 4) to which is preferably removably secured the aforementioned rotary wheel 46. Wheel 46 may be serrated on its exterior circumference, as at 54 (FIGS. 1 and 9) for facilitating rotation thereof by the finger of an operator and thus causing rotation of axle 52. The inner end of axle 52 has a preferably toothed pinion 56 formed thereon for providing a drive member received in coacting meshing relation (FIG. 5) with a toothed rack section 58 formed (FIGS. 5, 7 and 8) in the confronting side wall of carrier 36, which thus couples the carrier member 36 to the rotatable wheel 46. Upwardly facing rack 58 thus forms a trackway coacting with rotary pinion section 56 for driving carrier 36. As can be best seen in FIG. 5, upon rotation of the wheel 46 and associated stub axle 52 and member 56, the carrier member 36 is caused to move generally linearly in the upper chamber 38 of wrap-around housing 14, and thus move the rheostat contactor 48 relative to the resistance strip of rheostat 47, and move the bridging contacts 32, 32*a* relative to the respective group of stationary contacts of the variable speed switch, thus controlling the actuation of the associated electrically powered mechanism.

Wheel knob **46** has a centrally located opening **60** therethrough through which projects the stub axle **52**. The defining surface of opening **60** may be serrated, as **62** which serrations are adapted for gripping coaction with complementary serrations on the stub axle **52** for snugly securing the wheel **46** to the stub shaft against relative rotary movement. Wheel **46** may be removable from the stub axle by applying a withdrawal axial force thereto. It will be understood, however, that the wheel **46** could be fixed to the axle by other means such as by means of heat welding or by adhesive means. It will be seen that the reaction of the bridging contact springs **42** in conjunction with the smooth guiding surfaces defining chamber **38** of the wrap-around housing **14**, provide for the smooth generally linear movement of the carrier member during actuation of wheel **46** and resultant rotation of axle **52** and pinion **56**.

Referring now to FIGS. **11** through **15**, there is shown a modified embodiment of rotary control switch. In this embodiment, the main components of the speed control portion are substantially the same as those aforementioned in connection with the first described embodiment of rotary switch and like reference numbers have been utilized to designate such parts with the addition of a suffix prime added thereto. However, the rotary actuating means in this embodiment of rotary switch comprises a worm **70** having a threaded-like worm section **70*a*** and an elongated shank portion **70*b*** attached to the threaded portion **70*a*** and projecting outwardly therefrom. The worm member **70** is rotatably mounted in the wrap-around housing **14'** and may be retained in position by positioner **72** projecting from exteriorly of the wrap-around housing **14'** and extending into coaction in circumferential slot **74** on member **70** defined by collar **74*a*** (FIG. **14**) and the axially spaced threaded section **70*a***.

A spring loaded detent **76** may be provided on the housing **14'** and adapted to coact with recesses **78** formed in circumferential relationship on the shank **70*b***, for positioning the rotary actuating member in selected rotated positions with respect to the wrap-around housing **14'**. Threaded member **79** may be provided for adjusting the force of detent **76**. It will be seen that grasping of the shank **70*b*** by the fingers of the operator and rotating the same will cause the detent to be forced out of the respective recess **78** so as to permit rotary movement of the actuating member to another position.

The carrier member **36'** which is adapted to move generally linearly in chamber **80** of the wrap-around housing has a projection **82** (FIGS. **14** and **15**) projecting upwardly therefrom and disposed in coacting relation in the threaded groove of the worm section **70*a***. The carrier member **36'** carries the bridging contact members **32'**, **32*a'*** in the generally same manner as aforedescribed in connection with the first embodiment, with such bridging contact members being urged downwardly into engagement with the respective underlying group of stationary contacts by respective resilient spring **42'**. It will be seen that rotation of the worm **70** by means of the exteriorly accessible shank portion **70*b*** will cause the carrier member **36'** to be moved in a lengthwise generally linearly direction with respect to the rotating worm section **70*a***, thus causing movement of the bridging contact members with respect to their underlying stationary contact members and movement of the slide rheostat contactor **48'** with respect to the resistance strip of the rheostat, to control the electrical energy applied to the electrically driven device. In this connection, the slide contactor has a tab **48*a'*** extending into coaction with the carrier member **36'** and in a generally similar manner as aforedescribed in connection with the first embodiment. As can be best seen in FIG. **14**, the projection **82** on the carrier member **36'** extends upwardly through a slot **86** in upper surface of chamber **80**, and into coaction with the groove of worm section **70*a***, so that the carrier member is guided in its linear movement in chamber **80**.

From the foregoing description and accompanying drawings it will be seen that the invention provides a novel compact electrical control switch which utilizes a rotatable actuator means for actuating the switch and wherein the switch may be of a speed control-type embodying stationary contact means and bridging contact means with the bridging contact means being mounted on a carrier member movable generally linearly with respect to the stationary contact means, and with there being means coacting with the carrier member for moving the carrier member linearly during rotary movement of the rotary actuator means, and with rheostat means disposed in circuit with the stationary contact means and operatively connected to the actuator means for actuation of the rheostat means during movement of the carrier member. The invention also provides a compact electrical speed control switch which is economical to manufacture and is of a miniature size for ready incorporation into a plurality of electrically powered components, such as for instance, hand powered tools, utensils and the like.

The terms and expressions which have been used are used as terms of description and not of limitation, and there is no intention in the use of such terms and expressions of excluding any equivalents of any of the features shown or described, or portions thereof, and it is recognized that various modifications are possible within the scope of the invention claimed.

What is claimed is:

1. In a compact variable speed electrical control switch comprising spaced stationary contact means and movable bridging contact means adapted to move relative to said stationary contact means, with the bridging contact means being movable from an off position wherein the bridging contact means is spaced from at least one of the stationary contact means to an on position wherein the bridging contact means engages the stationary contact means in electrically conducting relation, and vice versa, actuator means for selectively moving said bridging contact means, said actuator means comprising a rotatable member, another member operatively coupled to said rotatable member for generally linear movement upon rotary movement of said rotatable member, and said other member coacting with said bridging contact means for moving the latter to and from said on position upon predetermined rotary movement of said rotatable member, and including speed control means in circuit with said stationary contact means and being operatively connected to said actuator means for actuation by the latter during rotary movement of said rotatable member.

2. A switch in accordance with claim 1 wherein said other member comprises a carrier mounting said bridging contact means thereon, said carrier being adapted for generally linear movement with respect to said stationary contact means, and said rotatable member having means thereon coacting with means on said carrier for moving said carrier generally linearly during rotary movement of said rotatable member.

3. A switch in accordance with claim 2 wherein said carrier comprises a recess therein, resilient means disposed in said recess and coacting with the respective bridging contact means received in said recess for urging the respective bridging contact means outwardly toward engagement with the respective stationary contact means.

4. In a compact electrical control switch comprising spaced stationary contact means and movable bridging contact means adapted to move relative to said stationary contact means, with the bridging contact means being movable from an off position wherein the bridging contact means is spaced from at least one of the stationary contact means to an on position wherein the bridging contact means engages the stationary contact means in electrically conducting relation, and vice versa, actuator means for selectively moving said bridging contact means, said actuator means comprising a rotatable member, another member operatively coupled to said rotatable member for generally linear movement upon rotary movement of said rotatable member, and said other member coacting with said bridging contact means for moving the latter to and from said on position upon predetermined rotary movement of said rotatable member, and wherein said rotatable member comprises a rotary worm and said other member comprises a carrier mounting said bridging contact means thereon, and means on said carrier coacting with said rotary worm for moving said carrier generally linearly and thus moving said bridging contact means relative to said stationary contact means during rotation of said worm.

5. In a compact electrical control switch comprising spaced stationary contact means and movable bridging contact means adapted to move relative to said stationary contact means, with the bridging contact means being movable from an off position wherein the bridging contact means is spaced from at least one of the stationary contact means to an on position wherein the bridging contact means engages the stationary contact means in electrically conducting relation, and vice versa, actuator means for selectively moving said bridging contact means, said actuator means comprising a rotatable member, another member operatively coupled to said rotatable member for generally linear movement upon rotary movement of said rotatable member, and said other member coacting with said bridging contact means for moving the latter to and from said on position upon predetermined rotary movement of said rotatable member, and wherein said switch is a speed control type switch including rheostat means in circuit with said stationary contact means and being operatively connected to said actuator means for actuation by the latter during rotary movement of said rotatable member.

6. A switch in accordance with claim 5 wherein said other member mounts said bridging contact means and is coupled to said rheostat means to cause generally linear movement of said bridging contact means and said rheostat means during rotary movement of said rotatable member.

7. A switch in accordance with claim 5 wherein said rotatable member comprises a wheel-like knob.

8. A switch in accordance with claim 5 wherein said rotatable member comprises a worm.

9. A switch in accordance with claim 5 wherein said stationary contact means comprises a group of at least three contact elements in generally longitudinally spaced relationship to one another, said bridging contact means being engageable in electrically conducting relation with two of said three contact elements in said on position.

10. A switch in accordance with claim 9 including two spaced groups of stationary contact means, one of said groups comprising said three contact elements and the other of said groups comprising a pair of stationary contact elements, said bridging contact means comprising a pair of spaced bridging contact members each being movable with respect to a respective one of said groups of stationary contact means, said other member having spaced recesses therein mounting said bridging contact members.

11. A switch in accordance with claim 5 wherein said rheostat means comprises a resistance strip and an electrically conductive slide contactor slidable relative to said resistance strip, said contactor having means thereon mechanically coupling said contactor to said other member for actuation of said contactor during actuation of said rotatable member.

12. A switch in accordance with claim 11 including a switch case in which said rheostat means is disposed and wherein said slide contactor is adapted to move generally linearly along said resistance strip, said means on said contactor comprising an upstanding tab projecting through a slot in said switch case and coacting in interlocked relation with said other member for causing said generally linear movement of said slide contactor during rotary movement of said rotatable member, said rotatable member having a rotary drive thereon coacting with a trackway means on said other member, said switch having a housing defining an elongated chamber in which said other member is disposed for movement generally lengthwise of said chamber, said coaction between said rotary drive and said trackway means on said other member causing said lengthwise movement of said other member and said linear movement of said contactor during rotary movement of said rotatable member.

13. A switch in accordance with claim 12 wherein said rotary drive comprises a toothed rotary wheel, said trackway means on said other member extending in a direction generally lengthwise of said other member and comprising a rack-like section so that upon rotary movement of said wheel said other member is caused to move linearly in said chamber.

14. A switch in accordance with claim 5 including a switch housing having a recess therein, a separable switch case mounting certain of the switch components including said rheostat means and said stationary contact means, said recess receiving therein said switch case and assembled switch components, said other member being movably disposed in said housing and

mounting said bridging contact means in said housing in movable relation thereto and in generally confronting relation to said stationary contact means, said housing mounting said rotatable member thereon.

15. A switch in accordance with claim **14** wherein said rotatable member comprises a rotary worm having a threaded-like worm portion and a shank portion extending axially from said worm portion, said shank portion projecting outwardly of said housing, and means on said housing coacting with said worm for releasably positioning said rotatable member in predetermined rotational relationship with respect to said housing so as to position said other member in predetermined relation with respect to said stationary contact means.

16. A switch in accordance with claim **15** wherein the last mentioned means on said housing comprises a resilient detent extending into engagement with said shank portion of said worm, and means on said shank portion adapted for releasable holding coaction with said detent means, for releasably positioning said rotatable member and said other member with respect to said stationary contact means.

17. A switch in accordance with claim **15** wherein said other member comprises a projection thereon extending into coaction with said worm portion for causing generally linear movement of said other member in said housing upon rotary movement of said worm.

18. A switch in accordance with claim **5** including a switch housing having a recess therein receiving a switch case and assembled switch components therein, said switch components including said rheostat means and said stationary contact means, said housing mounting said rotatable member thereon and having an opening therein, said rotatable member having an axle thereon rotatably projecting through said opening with means adjacent the inner end thereof disposed in driving coaction with said other member for moving the latter linearly during rotary movement of said rotatable member.

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