Sept. 22, 1970 R. E. LARKIN 3,530,319

SWITCH ASSEMBLY FOR ADJUSTABLE SPEED TOOL

Filed March 26, 1969 3 Sheets-Sheet 1

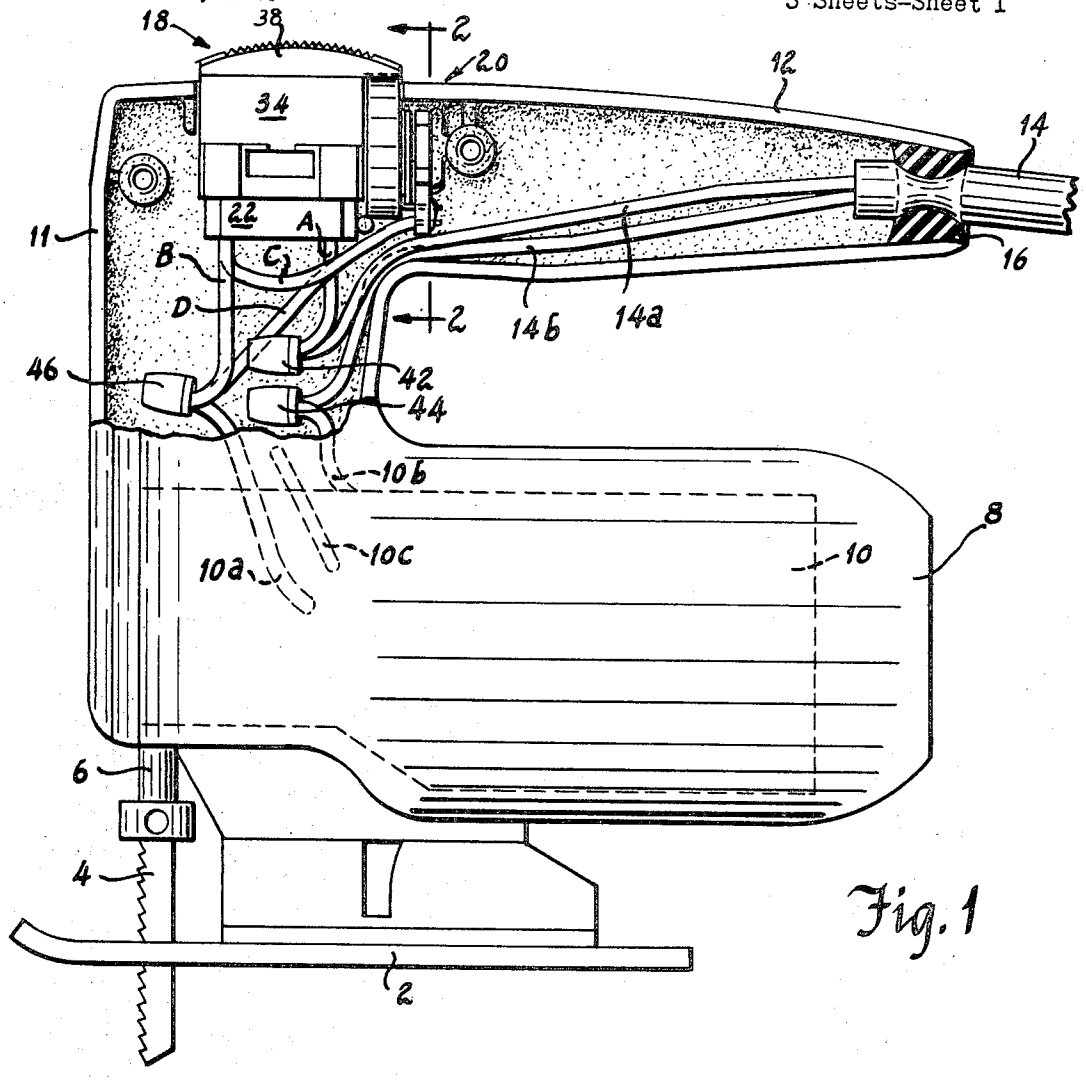
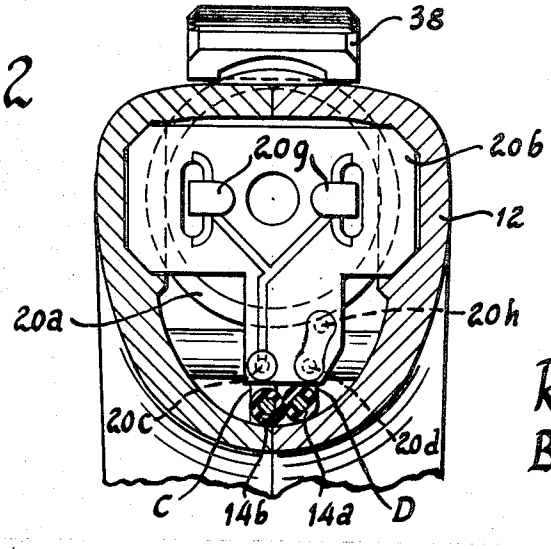


Fig. 1

Fig. 2

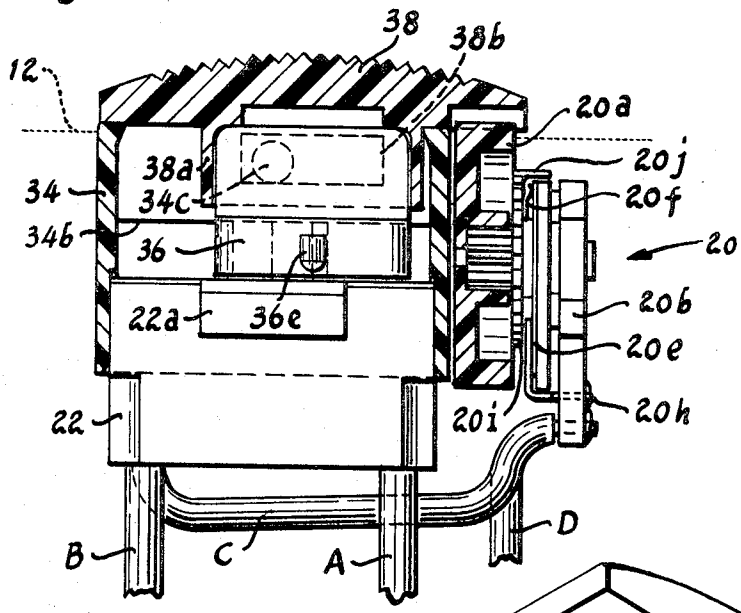


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SWITCH ASSEMBLY FOR ADJUSTABLE SPEED TOOL

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Fig. 3



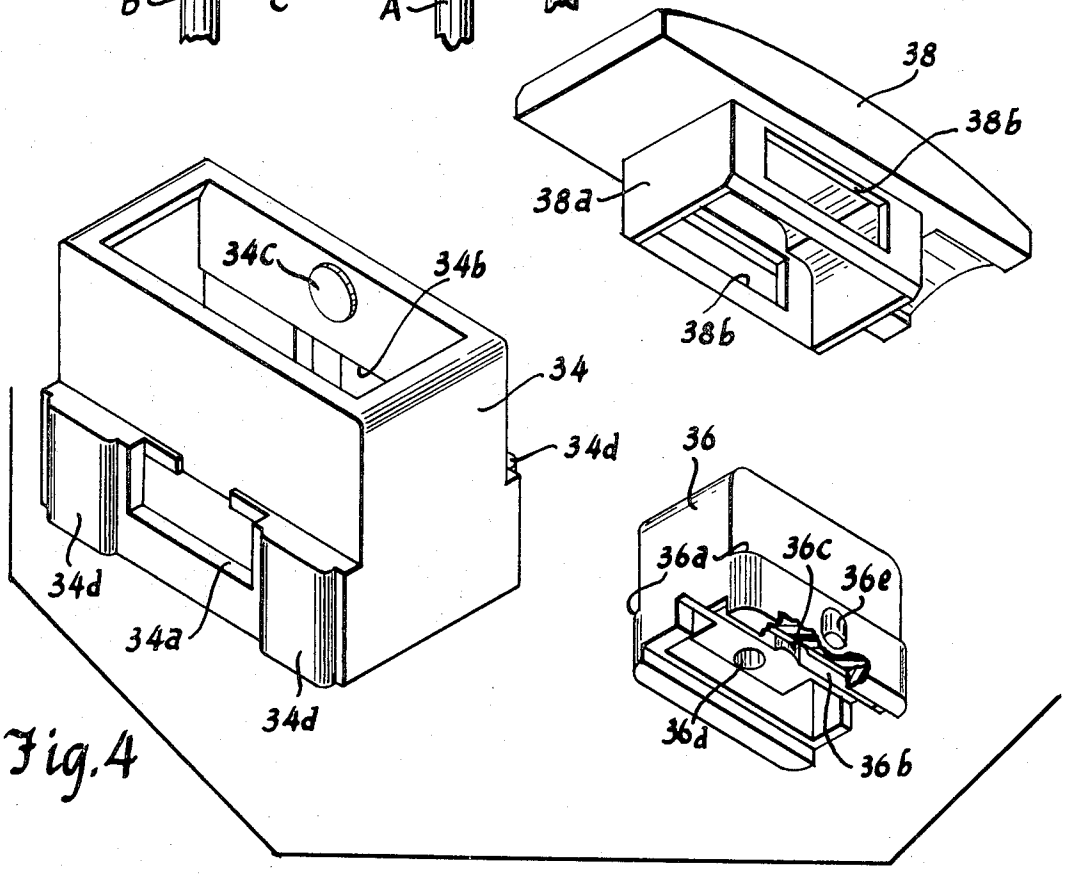


Fig. 4

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Fig. 5

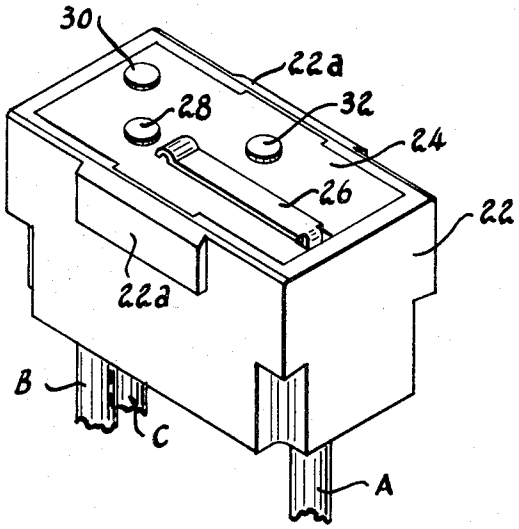


Fig. 6

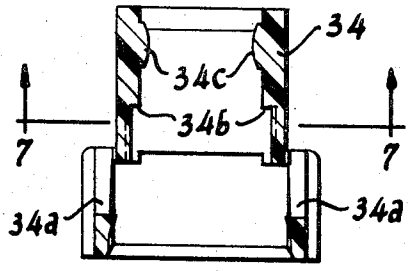


Fig. 7

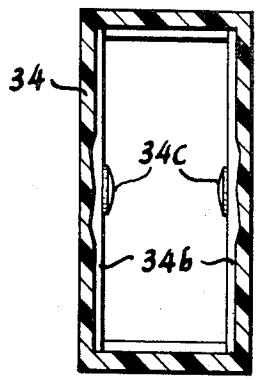
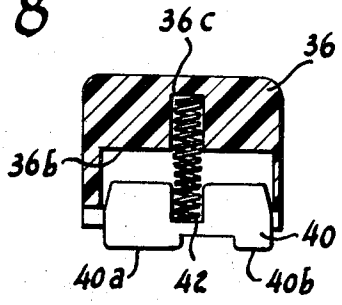


Fig. 8



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3,530,319

SWITCH ASSEMBLY FOR ADJUSTABLE SPEED TOOL

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Int. Cl. H02k 7/14
U.S. Cl. 310—50 9 Claims

ABSTRACT OF THE DISCLOSURE

A slide button tool handle switch having an on-off switch in the upper part of its housing and an adjustable speed motor control circuit in the lower part of its housing with the connecting leads coming out through the bottom. A rotary button operated, speed adjusting, variable resistor is connected to the motor control circuit and mounted in the tool handle so that one end of the slide button in its off position covers the rotary button to prevent any change in the speed adjustment when the tool is turned off.

BACKGROUND OF THE INVENTION

Adjustable speed tool handle devices have been known heretofore. L. B. Benkert and M. R. Dummer copending application Ser. No. 686,606, filed Nov. 29, 1967, entitled Universal Power Control Module for Portable Tool or Applicance Control Apparatus, and assigned to the assignee of this invention, discloses an adjustable speed module hidden within the tool handle and a self-supported switch and a self-supported variable resistor mounted in the handle so that their operators are exposed in spaced apart relation on top of the handle for manipulation by the operator. H. W. Brown Pat. No. 3,329,842, dated July 4, 1967, entitled Speed Controllers for Portable Devices, discloses a speed control trigger switch having a trigger that controls both the on-off switch and the variable resistor of the adjustable speed control circuit at the same time.

The present invention is an improvement thereon.

SUMMARY OF THE INVENTION

This invention relates to adjustable speed tool handle switches of the type whereby the tool motor speed may be set at a desired value and then the tool may be stopped and restarted repeatedly without affecting the speed setting.

An object of the invention is to provide an improved adjustable speed tool handle switch.

A more specific object of the invention is to provide adjustable speed tool handle apparatus having an on-off switch actuator arranged to conceal a speed control button in one of its positions and being movable therefrom to expose the speed control button for actuation.

Another specific object of the invention is to provide adjustable speed tool handle apparatus having a slide button on-off switch arranged to enclose in its housing a solid state speed control circuit, and a speed adjusting variable resistor mounted so that its rotary button is covered by one end of the switch slide button in its off position.

Other objects and advantages of the invention will hereinafter appear.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a left side elevational view of a sabre saw having a part of its housing and handle broken away to show the adjustable speed tool handle apparatus and its connections;

FIG. 2 is an enlarged cross-sectional view taken along line 2—2 of FIG. 1 showing the connection and mounting means of the variable resistor;

FIG. 3 is an enlarged view partly in section of the adjustable speed tool handle apparatus of FIG. 1;

FIG. 4 is an enlarged, exploded, isometric view of the slide button, contact carrier partly broken away to show the movable contact slot and spring slot, and cover of the apparatus of FIG. 3;

FIG. 5 is an enlarged isometric view of the base of the apparatus of FIG. 3;

FIG. 6 is a transverse cross-sectional view of the cover of FIG. 4;

FIG. 7 is a cross-sectional view taken on line 7—7 of FIG. 6; and

FIG. 8 is a cross-sectional view through the contact carrier showing the movable bridging contact and its bias spring.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, there is shown one application of the invention in a manual or portable electric tool such as a sabre saw.

The sabre saw is of the conventional type having a base plate **2** adapted to slide along the workpiece to be sawed, a saw blade **4**, a drive shaft **6** to which the saw blade is attached, a housing **8** for the electric motor and drive mechanism **10** shown in broken line that reciprocates drive shaft **6**. The front end **11** of the motor housing extends up and then back over the motor housing to form a hollow handle **12** for mounting the motor control apparatus and power line.

As shown in FIG. 1, power line **14** enters the handle at its unsupported end and suitable strain relief means **16** is provided at the entry point to avoid pulling on the internal conductors. This power line has a pair of electrical conductors **14***a* and **14***b* for connection to the motor and speed control apparatus as hereinafter described.

The tool motor in FIG. 1 may be provided with a pair of conductors **10***a* and **10***b* between which the armature and field windings are connected in series, for example, in the case of a universal motor that is conventionally used in small portable tools and appliances. The motor may be provided with a third conductor **10***c* connected to the junction between the armature and field windings for use in the event a feedback type speed control apparatus is used as hereinafter described.

As also shown in FIG. 1, a motor speed control apparatus is mounted in the hollow front end **11** and handle **12** of the sabre saw and is connected to the motor conductors and power line conductors.

This speed control apparatus comprises a self-enclosed slide button switch **18** and a self-supported variable resistor **20** electrically connected so that the variable resistor controls the speed control circuit in the switch housing to afford selective setting of the motor speed. The variable resistor is mounted directly behind the slide button switch so that its rotary button is concealed by the rear end of the slide button when the switch is in its off or open position.

This switch is shown in more detail in FIGS. 3–8. The switch housing comprises a lower portion or base **22** shown in FIGS. 3 and 5. This base is a generally rectangular box having an open top and holes at the bottom through which extend connection conductors A, B and C. The open top is closed by an insulating plate **24** having secured on the upper surface thereof stationary contacts **26** and **28** of the slide button switch. Contact **26** is a strip as shown in FIG. 5 along which the movable contact slides and contact **28** is a flat-headed rivet that is bridged to contact **26** by the movable contact when the slide button

is pushed forward. One end of contact **26** extends down into the compartment in the base wherein it is connected to connector A.

The compartment within the base accommodates a solid state speed control circuit of conventional type. This circuit is connected to contact **28** and conductors B and C and also to connectors suspended from the lower surface of the insulating plate by rivets **30** and **32**. Speed control circuits usable herein are well known and the details thereof have not been shown to avoid complicating the drawing. An example of a half-wave speed control circuit that could be used herein is shown in FIG. 3 of the aforementioned H. W. Brown Pat. No. 3,329,842. A full-wave speed control circuit that is preferably used herein is shown in FIG. 3 of H. W. Brown and L. D. Thompson copending application Ser. No. 565,192, now Pat. No. 3,447,057 filed July 14, 1966, entitled Solid State Power Controller for A.C. Load Devices, and assigned to the assignee of this invention. A feedback type speed control circuit that is preferably used herein is disclosed in connection with FIGS. 2 and 3 of W. L. Rutchik copending application Ser. No. 746,120, filed July 19, 1968, entitled Trigger Switch Speed Control Unit with Electrical Feedback, and assigned to the assignee of this invention.

As shown in FIG. 5, base **22** is also provided at the upper central portions of its longer side walls with rectangular raised portions **22***a* integrally molded on the base that snap into complimentary apertures in the cover when the cover is pressed thereon as shown in FIG. 3, the adjacent parts of the cover being resilient to pass over such raised portions.

Cover **34** that snaps onto the base and supports a contact carrier **36** is shown in FIGS. 3, 4, 6 and 7. This cover is in the form of a rectangular shell open at the top and bottom and having the aforementioned apertures **34***a* on two opposite side walls as shown at the left side of FIG. 4 and in FIG. 6. This cover has a wider lower portion where it fits around the upper portion of the base and a relatively narrower upper portion wherein the contact carrier and slide button **38** are mounted for reciprocal sliding movement laterally along the length of the base and cover. Apertures **34***a* are located centrally of the side walls of the wider lower portion as shown in FIG. 4.

The upper portion of cover **34** has an overhanging step **34***b* in each of the longer inner walls as shown in FIG. 6 forming a slide for the two shoulders **36***a* on opposite side walls of contact carrier **36**. The inner walls of the cover are provided with circular projections **34***c* at the upper central portions thereof directed toward each other for retaining the slide button in sliding engagement with the cover. For this purpose, slide button **38** has a reduced, hanging skirt **38***a* provided with rectangular apertures **38***b* in opposite longer sides thereof. When the slide button is pressed into the cover, it snaps into place with projections **34***c* entering apertures **38***b* to hold the slide button in place but allowing sliding reciprocal movement thereof.

Contact carrier **36** is then inserted into the cover from below so that its narrower upper portion enters into skirt **38***a* of the slide button and fits snugly therein so that it will move with the slide button within the cover. Contact carrier **36** is inserted until shoulders **36***a* thereof abuts against overhanging shoulders **34***b* in the cover.

The lower, wider portion of contact carrier **36** is provided with means for retaining a movable bridging contact **40** and its biasing spring **42** as shown in FIGS. 4 and 8. This means comprises a narrow groove **36***b* slightly wider than the flat bridging contact and extending upwardly from the bottom of the contact carrier. A round bore **36***c* extends up through the middle of this groove and higher than the bottom of the groove for holding a helical compression spring that resiliently biases the movable contact downwardly to afford suitable contact pressure. Groove **36***b* is located in the contact carrier so that the movable contact will engage the stationary contacts.

The additional recesses and bore **36***d* in alinement alongside the movable contact are used only when the variable resistor is built into the switch housing and have no function in the present invention. These recesses make the contact carrier a universal type, for use with both an internal variable resistor and an external variable resistor, the latter being used herein.

As shown in FIG. 7, cover **34** is provided with a cam surface on each of two inner walls below shoulders **34***b*. These cam surfaces have two deeper-cut "stable" positions in alinement with those on the other wall to serve as detents for on and off positions of the switch. The contact carrier is provided with a suitable, short, vertical rib **36***d* on each of two outer walls as shown in FIG. 3. These ribs slide along the cam surfaces to give "feel" to switch operation and accelerate into and maintain the switch in the on and off positions.

The switch is shown in its off or open position in FIG. 3. In this position, both contacting portions **40***a* and **40***b* shown in FIG. 8 rest on contact strip **26**. When the slide button is moved forward as by the thumb of the user, contacting portion **40***a* rides on the hump on the contact strip and upon further movement drops down onto contact **28** to connect the two stationary contacts and close a circuit from the power supply to the motor through the speed control circuit. The hump on the contact strip effects a quick break of the contacts when the slide button is moved back.

With the switch in its off position as shown in FIG. 3, the rear end of the slide button is long enough to overlie and conceal the rotary operating button **20***a* of variable resistor **20**. This button is rotated as by the thumb of the user to set the speed of the motor. Since the slide button must be pushed to its on position before this rotary button can be turned, it will be seen that the speed cannot be tampered with or accidentally changed while the tool is turned off. Thus, the operator can always come back to the previous speed merely by closing the slide button switch. If speed change is desired, it can best be done while the tool is running and the operator can observe it.

The variable resistor is provided with means adapting it for mounting in the hollow handle of the tool. This means comprises a generally rectangular printed circuit board **20***b* with its corners cut off as shown in FIG. 2 to fit snugly into complimentary grooves in the inner walls of the tool handle and clamped therebetween. In this manner, the variable resistor is rigidly mounted in the tool handle with the upper periphery of its rotary button **20***a* extending sufficiently above the surface of the handle for rotation by the user as shown in FIGS. 1–3.

This variable resistor is provided with a pair of conductors between which the resistance may be adjusted by turning the button. One of these conductors is conductor C that comes from the speed control circuit within base **22** of the switch and connects to terminal **20***c* shown in FIG. 2. The other one is conductor D that connects to terminal **20***d* as shown in FIGS. 2 and 3.

One of these terminals is connected to one end of a resistor strip **20***e* and the other terminal is connected to a slider **20***f* shown in FIG. 3. For this purpose, board **20***b* has a printed connection from terminal **20***c* as shown in FIG. 2 to a pair of bent-over tabs **20***g* that are soldered thereto. These tabs are part of the metal frame of the assembly to which slider **20***f* is slidably and electrically connected. Board **20***b* has a printed connection from terminal **20***d* to connector **20***h* to which this connector is soldered as shown in FIG. 2. The other end of this connector is clamped into contact with one end of resistor strip **20***e* as by tabs that extend through the backing board of the resistor strip as shown in FIG. 3. The other end of the resistor strip is left unconnected. The resistor strip is in the form of a broken annular ring so that slider **20***f* when rotated varies the resistance across conductors C and D. The hub on which the rotary button **20***a* is secured is integral with a disc **20***i* knurled on its periphery and having

a pointer **20***j* secured thereto indicative of the position of the slider as shown in FIG. 3.

The switch housing is provided with means adapting it for rigid securing in the front portion of the tool housing. This means comprises projections **34***d*, best shown in FIG. 4, on the wider portion of cover **34** whereby the slide button is nested and fixed in the tool housing.

As shown in FIG. 1, conductor **14***a* of the power line is connected by a speed nut **42** to conductor A of the speed control circuit. Conductor **14***b* of the power line is connected by speed nut **44** to motor conductor **10***b*. Conductor C is connected between the slider and the speed control circuit. And conductor D is connected from the resistor strip by a speed nut **46** to conductor B of the speed control circuit and motor conductor **10***a*. This puts the speed control circuit and the variable resistor in a system effective to control the motor speed.

While the apparatus hereinbefore described is effectively adapted to fulfill the objects stated, it is to be understood that the invention is not intended to be confined to the particular preferred embodiment of adjustable speed tool handle apparatus disclosed, inasmuch as it is susceptible of various modifications without departing from the scope of the invention. For example, the switch actuator might take other forms or other parts thereof such as a side might be used to cover the rotary button.

I claim:

1. In a portable tool having a hollow housing including electric wires extending thereinto from the tool motor and power line that is adapted to be connected to a power supply source, a motor control apparatus for starting and stopping and adjusting the speed of the motor concurrently with use of the tool comprising:

a self-enclosed switch having an insulating enclosure and a manual operator at the top of the enclosure;

means adapting said switch for mounting in the housing of a portable electric tool with its manual operator exposed above the housing for actuation by the hand of the user;

switch contact means in the upper part of said enclosure arranged for actuation by said manual operator to close the motor power circuit;

a speed control circuit in the lower part of said enclosure connected to said switch contact means and to conductors extending through the enclosure whereby said speed control circuit is adapted to be connected to said electric wires;

said manual operator having a portion that projects laterally from said enclosure when said switch is in one of its positions;

a self-supported variable resistor having a manual button for adjusting its resistance and connectors adapting it for connection to said conductors;

and means on said self-supporting variable resistor adapting it for mounting in the tool housing so that its manual button is covered by said projecting portion of the switch operator in said one position and is exposed for actuation in another position thereof.

2. The invention defined in claim **1**, wherein said manual operator of said switch comprises:

a slide button mounted for reciprocal movement on the top of said switch enclosure.

3. The invention defined in claim **2**, wherein said projecting portion of said manual operator comprises:

an extension on the rear end of said slide button that slides over the adjusting button of the variable resistor when said slide button is retracted from its forward "on" position to its "off" position.

4. The invention defined in claim **3**, wherein said manual button of said variable resistor comprises:

a rotary member mounted for actuation by a movement

transverse to the forward-rearward movement required for actuation of said slide button.

5. The invention defined in claim **4**, wherein said extension on the rear end of said slide button comprises:

a recess in its lower surface providing clearance for said rotary member.

6. In a portable tool having a housing including a hollow handle and electric wires extending thereinto from the tool motor and power line that is adapted to be connected to an alternating current source, a motor control apparatus for starting and stopping and controlling the speed of the motor concurrently with use of the tool comprising:

a self-enclosed switch having a manual operator at the top and an insulating housing enclosing two compartments including an upper compartment next to the manual operator and a lower compartment;

means adapting said switch for mounting in the handle of the tool with its manual operator exposed for actuation by the hand of the user;

switch contact means in said upper compartment arranged for actuation by said manual operator to close the motor power circuit;

a solid state speed control circuit in said lower compartment connected to said switch contact means and to conductors extending through a wall of the housing whereby said speed control circuit is adapted to be connected by the electric wires in the motor power circuit;

said manual operator having a portion that projects from said switch housing when said switch is in its open position;

a self-supported variable resistor having a manual button for adjusting its resistance and conductors adapting it for connection to the first mentioned conductors;

and means on said self-supported variable resistor adapting it for mounting in the handle so that its manual button is covered by said projecting portion of the switch operator.

7. The invention defined in claim **6**, wherein said manual operator of said switch comprises:

a slide button arranged to be slid forward by the thumb of the user to close the switch contact means when the tool is held in the hand and to be slid rearward to reopen the switch contact means;

8. The invention defined in claim **7**, wherein said manual button of said variable resistor comprises:

a rotary member mounted directly to the rear of said switch housing so that the rear end of said slide button overlies the same in the open position of the switch and exposes the same for actuation by the thumb of the user in the closed position of the switch.

9. The invention defined in claim **8**, wherein said rotary member is mounted for rotation by a movement transverse to the movement of the slide button.

References Cited

UNITED STATES PATENTS

3,156,804	11/1964	Springer et al.	310—50 X
3,221,192	11/1965	Franklin	310—68
3,225,232	12/1965	Turley et al.	310—50 X
3,329,842	7/1967	Brown	310—68
3,447,057	5/1969	Brown et al.	318—345
3,456,230	7/1969	Matthews et al.	318—345 X
3,458,793	7/1969	Tsergas	310—50 X
3,470,339	9/1969	Roman	200—50

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U.S. Cl. X.R.

310—68; 200—157; 338—200; 318—345

PO-1050
(5/69)

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,530,319 Dated September 22, 1970

Inventor(s) Robert E. Larkin

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 3, line 3, change "connector" to -- conductor --;

line 33, change "is" to -- as --;

line 61, change "abuts" to -- abut --

Column 4, line 12, change "36d" to -- 36e --.

Column 5, line 21, after "of" insert -- switch assembly for --;

line 22, cancel "handle";

line 36, after "manual", insert -- switch --.

Column 6, line 13, after "manual", insert -- switch --.

Signed and sealed this 21st day of September 1971.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Acting Commissioner of Patents