United States Patent

Gawron

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[54] TRIGGER OPERATED SPEED CONTROL ASSEMBLY FOR ELECTRICAL MOTORS

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[73] Assignee: **Skil Corporation,** Chicago, Ill.

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Related U.S. Application Data

[63] Continuation of Ser. No. 438,627, Mar. 10, 1965, abandoned.

[52] **U.S. Cl.** **318/345**

[51] **Int. Cl.** **H02p 5/16**

[58] **Field of Search** 318/345

[56] **References Cited**

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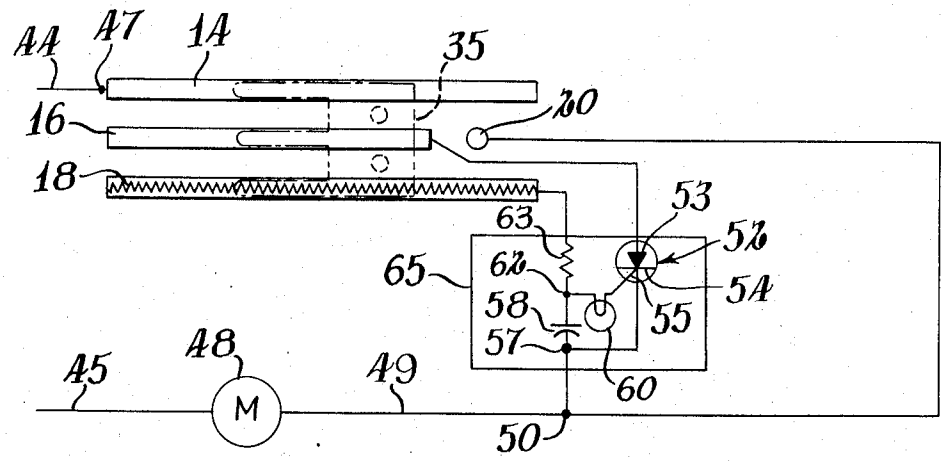
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[57] **ABSTRACT**

A trigger operated switch includes three contact strips and a bypass contact button. The trigger carries three slides for respective sliding engagement with such strips. Two of the strips are adapted for connection with a speed control circuit, one strip cooperating with one slide to define a variable resistor of such circuit. When the trigger is fully depressed, one of the slides is in engagement with the contact button for bypassing the speed control circuit.

2 Claims, 5 Drawing Figures



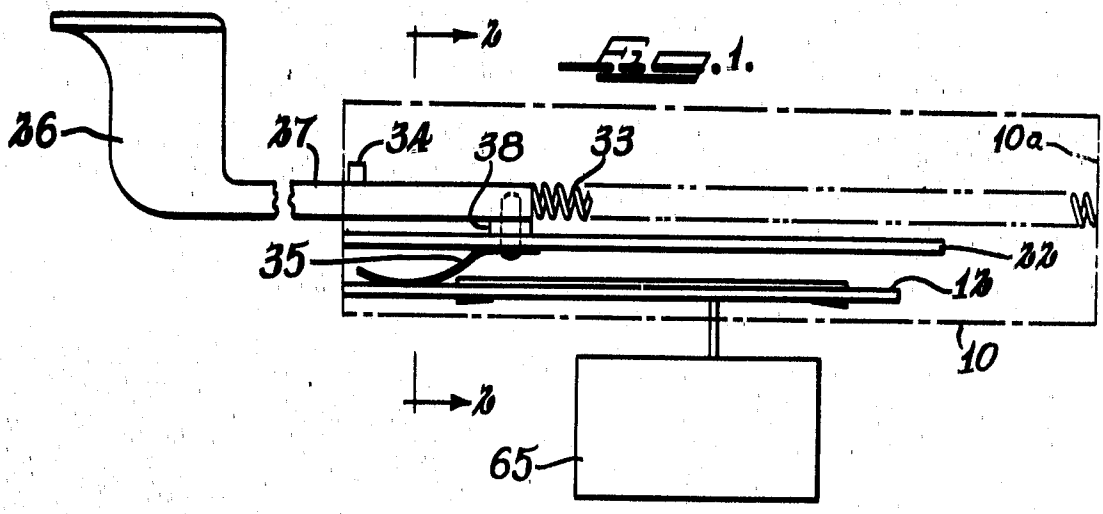


Fig. 1.

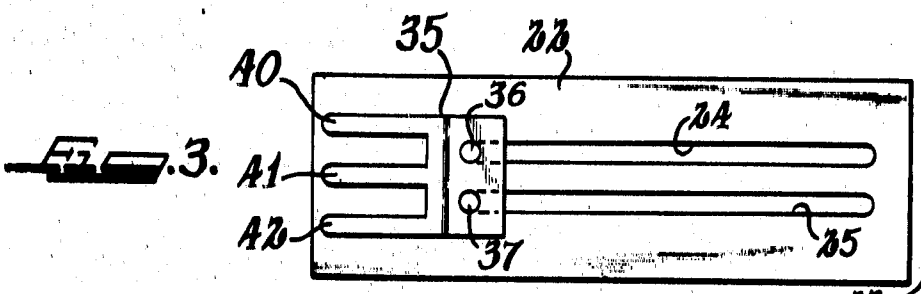


Fig. 3.

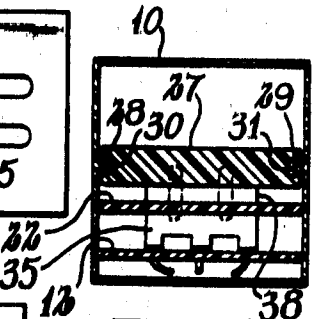


Fig. 2.

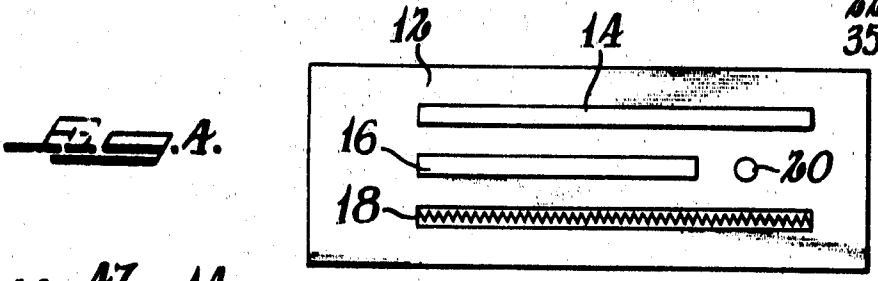


Fig. 4.

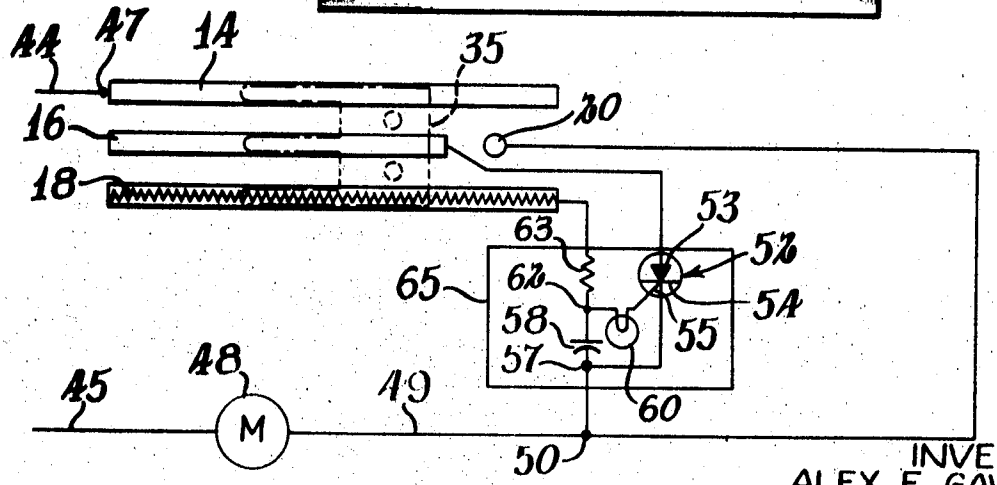


Fig. 5.

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TRIGGER OPERATED SPEED CONTROL ASSEMBLY FOR ELECTRICAL MOTORS

This application is a continuation of application Ser. No. 438,627, filed Mar. 10, 1965, now abandoned.

This invention relates to controls for electric motors, and more particularly to a new and improved trigger operated speed control assembly for electric motors.

A primary object of the present invention is the provision of a speed control assembly of the type described, which assembly includes a trigger operated slide switch of unique construction.

A further object of the present invention is the provision of an assembly of the type described including a new and improved trigger operated slide switch in unique cooperation with a silicon controlled rectifier speed control circuit.

Another object of the present invention is the provision of an assembly of the type described including a new and improved slide switch in cooperation with a silicon controlled rectifier circuit, which switch includes means for shunting the silicon controlled rectifier circuit when the trigger is in the full on or maximum speed position.

Even another object of the present invention is the provision of a trigger operated speed control assembly of the type described, which assembly lends itself to small and compact construction, thereby readily adapting it for incorporation in a hand manipulatable tool, as for example a power drill.

Still another object of the present invention is the provision of an assembly of the type described including a trigger operated slide switch including means forming a variable resistor for cooperation with an associated silicon controlled rectifier circuit.

These and other objects and advantages of the invention will become apparent from the following specification disclosing a preferred embodiment of the invention which is illustrated in the accompanying drawing wherein:

FIG. 1 is a side elevation of the assembly of this invention with the trigger housing being shown in phantom lines;

FIG. 2 is a section taken along line 2—2 of FIG. 1;

FIG. 3 is a bottom plan view of the slider and upper board of the slide switch of this invention;

FIG. 4 is a top plan view of the lower board forming a part of the switch of this invention; and

FIG. 5 is a diagrammatic view primarily showing the contact strips of the slide switch and an associated silicon controlled rectifier circuit.

Referring now to FIGS. 1 and 2, the trigger operated speed control assembly of this invention will be seen to include a generally elongated, box-like switch housing **10**, which housing may be of any suitable construction. The housing is shown in phantom lines in FIG. 1 for better illustration of the slide switch mounted within the housing.

Suitably mounted in housing **10** is a board **12** formed of insulating or non-conducting material. As noted in FIG. 4, board **12** supports three parallel contact strips **14**, **16** and **18**, which strips are spaced from each other and extend lengthwise of board **12**. It will be noted that strip **16** is shorter than strips **14** and **18**. A contact **20** is mounted on board **12** adjacent the end of strip **16** which is offset or spaced from the corresponding ends of the adjacent strips. It will be understood that strips **14** and **16** are of suitable conductive material. Strip **18** is formed of conductive material having a relatively high resistance value, such as carbon for example, and as will be explained hereinbelow strip **18** forms one part of a variable resistor.

A board **22** is suitably mounted in housing **10** in parallel spaced relation above board **12**. Board **22** includes a pair of parallel slots **24** and **25** which extend lengthwise of the board.

A trigger **26** includes an integral bar-like extension **27** which extends into an opening (not shown) in the forward end of housing **10**. Trigger bar **27** includes longitudinally extending, oppositely facing grooves **28**, **29** in the side faces thereof, which grooves slidably receive respective ribs **30**, **31** formed integrally with the side walls of housing **10**. It will be appreciated that trigger bar **27** is slidably associated with the

housing thereby to mount the trigger for reciprocal movement longitudinally or axially of housing **10**. A coil spring **33** has one end thereof abutting the end of trigger bar **27** and the other end thereof abutting a closed end **10a** of the trigger housing thereby to urge the trigger outwardly (to the left as seen in FIG. 1) of housing **10**. Trigger bar **27** includes a stop **34** adapted to abut the front (not shown) of housing **10** thereby to limit outward movement of the trigger.

Trigger **26** carries a slider **35** for reciprocal movement along with the trigger. Slider **35**, which is disposed between boards **12** and **22**, is secured to trigger bar **27** by means of a pair of fasteners **36**, **37**, which fasteners extend through respective slots **24**, **25** in board **22**. Fasteners **36**, **37** extend through a spacer or spacers **38** (FIG. 1) and are suitably secured to trigger bar **27**. It will be understood that spacer **38** is adapted to slide along the upper surface of board **22** and that slider **35** is adapted to slide along the underside of board **22**. Fasteners **36**, **37** of course slide in respective grooves **24**, **25** in the upper board **22**.

As best seen in FIG. 3, slider **35** includes three integral slides or fingers **40**, **41**, and **42**. The slider, which is made of resilient or spring-like conductive material, is so constructed that the arcuate slides are biased into sliding engagement with lower board **12**. As the slider is reciprocated, slides **40**, **41** and **42** come into respective sliding engagement with contact strips **14**, **16** and **18**, respectively.

FIG. **5** diagrammatically illustrates the contact strips of the slide switch in association with a circuit including a silicon controlled rectifier circuit. In FIG. **5**, the numerals **44** and **45** represent the lines or conductors from a suitable source of alternating current operating at a frequency of 60 cycles and a voltage of 117 volts, for example. A line or conductor **44** representing one side of the alternating current source is connected to contact strip **14** at a terminal **47**. Line **45** is in series circuit relation with a load device in the form of a universal or series type motor **48**. A line **49** connects the motor with a terminal **50**.

In order to cause the silicon controlled rectifier **52** to become conducting in the half cycle of the alternating current that it is adapted to conduct, a circuit is associated with the gate of the silicon controlled rectifier. This circuit includes a neon bulb **60** connected to gate **55** of the silicon controlled rectifier. The neon bulb is interposed between the control electrode of the silicon controlled rectifier and a common connection **62** between the capacitor **58** and a fixed resistor **63**. The resistor **63** is provided to limit the current which passes through the variable resistor formed by resistance strip **18** and slide **42**. It will be realized that resistor **63** could be a part of resistance strip **18**. It will also be realized that a diode of a type such as a trigger or zener may be substituted for neon bulb **60**.

It will be noted that contact strip **18** of the slide switch is connected to the fixed resistor **63** of the silicon controlled rectifier circuit. It will also be noted that contact **20** is connected with terminal **50**.

When trigger **26** is in its position illustrated in FIG. **1** with the stop **34** being urged into engagement with the front of the housing by means of spring **33**, slides **40**, **41** and **42** are separated or spaced from respective contact strips **14**, **16** and **18**. In other words, trigger **26** is illustrated in its off position in FIG. **1**. When trigger **26** is initially moved to the right as viewed in FIG. **1**, the slides come into respective sliding engagement with the contact strips on board **12**. When this occurs, it will be apparent that strip **14** is placed in electrical communication with strips **16** and **18**. This closes the silicon controlled rectifier circuit for energizing motor **48**.

As is known to those skilled in the art, silicon controlled rectifier **52** acts to conduct half cycles of alternating current of one polarity and to block the flow of the half cycles of the alternating current of opposite polarity. The variable resistor defined by contact strip **18** and slide **42** acts to vary the time rate voltage build-up on the capacitor **58** in the half cycle during which the silicon controlled rectifier **52** is adapted to con-

duct a half cycle of alternating current. As trigger **26** is moved from left to right as viewed in FIG. **1** thereby imparting corresponding movement to slide **42** along contact strip **18** for reducing the resistance of the variable resistor defined by slide **42** and strip **18**, the voltage applied to capacitor **58** is increased with the result that the silicon controlled rectifier **52** is rendered conducting at an earlier point in the half cycle of alternating current that it is adapted to conduct with the further result that the voltage and current applied to motor **48** are correspondingly increased for increasing the speed of the latter. Accordingly, as the trigger is moved from left to right as viewed in FIG. **1**, the speed of motor **48** is increased. It will be apparent that when trigger **26** is moved from right to left there is a corresponding reduction in the voltage and current applied to motor **48** for reducing the speed of the latter.

When trigger **26** is moved to the right or pulled inwardly to a position wherein slide **41** passes from the end of strip **16** and comes into contact with contact **20**, the silicon controlled rectifier circuit is shunted and both half cycles of alternating current at the voltage existing between the lines or conductors **44** and **45** are applied to the load device, thereby to operate the same at maximum speed. When slide **41** engages contact **20**, the circuit for motor **28** is as follows: line **44**, terminal **47**, strip **14**, slider **35** (slides **40** and **41**), contact **20**, terminal **50**, line **49**, motor **48** and line **45**. When trigger **26** is in the position just mentioned, slide **41** no longer engages strip **16** and therefore the circuit to the anode of the silicon controlled rectifier is opened so that the latter is not activated.

It will be understood that switch housing **10** may be readily mounted in the handgrip portion of a hand manipulatable tool, such as an electric drill. In such a case, housing **10** is mounted within the handgrip portion of the drill so that the trigger **26** may be manipulated by the finger of a person's hand gripping the handgrip portion of the drill. In this respect, it should be mentioned that the length of the switch has been extended in the drawings for purposes of better illustration. Actually, the switch housing can be constructed with a length of between one inch and 1 ½inches, with a trigger stroke of approximately one-half inch. The silicon controlled rectifier circuit may be readily incorporated in a small electronic package represented by block **65** in FIGS. **1** and **5**, and suitably connected with the trigger housing. Of course, the trigger housing itself could be enlarged for enclosing the entire silicon controlled rectifier circuit thereby to provide a unitary trigger operated speed control assembly for incorporation in the handle of a hand manipulatable tool, such as a drill. It will be understood that housing **10**, or electronic package **65** if desired, mounts terminals **47**, **50** for connecting the trigger operated speed control assembly of this invention in one side of the alternating current line providing the source of current for energizing the motor **48**, which in the case of a drill would be the motor for the same. Preferably, the trigger and the entire slide switch with the exception of contact strips **14**, **16** and **18**, contact **20**, slider **35** and spring **33**, are made of suitable non-conducting material, such as plastic.

It should now be apparent that the trigger operated speed control of this invention provides a new and improved slide switch in unique cooperation with a silicon controlled rectifier circuit for activating the latter to provide motor speed control at an infinite number of speeds and for shunting the silicon controlled rectifier when maximum speed is desired.

While the invention has been shown in but one form, it will be obvious to those skilled in the art that it is not to be so limited. On the contrary, the invention is susceptible of various forms and modifications without departing from the spirit and scope of the appended claims. In this respect it will be realized that the contact strips may be arranged differently on their supporting board, i.e. shifted axially with respect to each other, and/or provided with different relative lengths so long as corresponding changes are made to the slides for accomplishing the same results brought about by the embodiment of the switch shown for purposes of illustration.

We claim:

1. A trigger operated control unit for use in controlling the speed of an electric motor in a hand manipulatable tool, said unit comprising, a base mounting first, second and third contact strips in spaced, parallel and insulated relation, a contact mounted on said base adjacent one end of said first strip and in insulated relation with the same, a conductive slider mounted for reciprocal movement axially of said strips, a trigger associated with said slider for reciprocating the same, said slider having first, second and third slides adapted for respective sliding engagement with said first, second and third strips for placing each strip in electrical communication with the other strips, said slides being arranged with respect to said strips so that as said slider is moved by said trigger in a direction toward said contact said slides slidably engage respective strips simultaneously until said first slide passes beyond said one end of said first strip whereby upon continued movement of said slider in said direction said second slide remains in sliding engagement with said second strip and said first slide comes into engagement with said contact, said third strip third strip having a resistance value and forming, with said third slide, a variable resistor, a speed control circuit including a thyristor, two of said contact strips being adapted for connection with said speed control circuit, said contact being adapted for connection with a bypass line for shunting said circuit.

2. A trigger operated speed control assembly for an electric motor comprising, a switch housing including a base mounting first, second and third contact strips in parallel, spaced and insulated relation, a contact mounted on said base in insulated relation with the latter and in adjacent relation with one end of said first strip, a trigger mounted in said housing for reciprocating movement axially of said strip between first and second positions, a conductive slider carried by said trigger, which slider includes first, second and third slides adapted for respective sliding engagement with said first, second and third strips, said slides being arranged so that when said trigger is in said first position at least one of said slides is separated from the associated strip, so that when said trigger is in said second position said first and second slides are in respective contact with said contact and said second strip, and so that during movement of said trigger between said first an second positions said slides slidably engage respective strips simultaneously, said third strip having a resistance value and forming, with said third slide, a variable resistor, a speed control circuit including a thyristor, two of said contact strips being adapted for connection with said speed control circuit, said contact being adapted for communication with a bypass line for shunting said circuit when said trigger is in said second position.

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