United States Patent

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[54] **ADJUSTABLE SWITCH DEVICE**
6 Claims, 7 Drawing Figs.

[52] **U.S. Cl.** **200/157**
[51] **Int. Cl.** **H01h 9/06**
[50] **Field of Search** 200/157

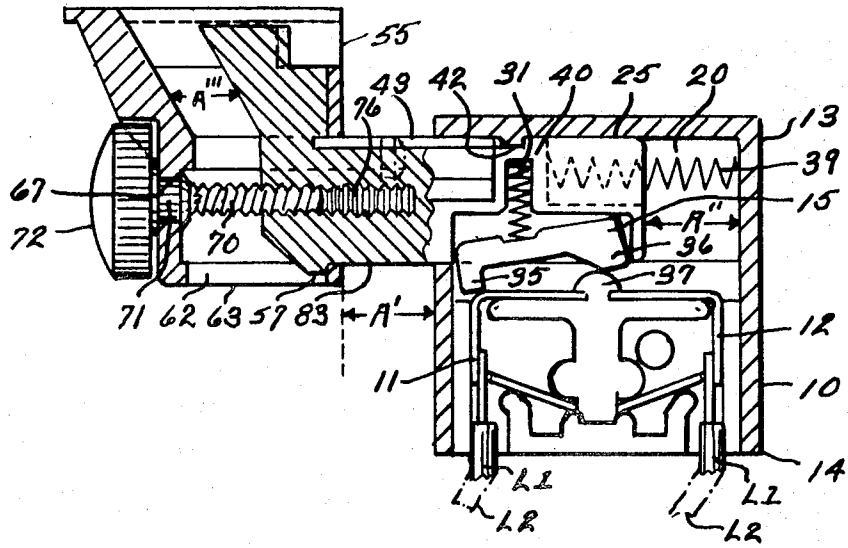
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ABSTRACT: A trigger-operated electrical switch for a portable electric motor-driven tool to control the application of electrical energy from an energy source to the motor. The switch includes stationary contaCt elements and a stationary resistance element connected into an electrode circuit. The switch also includes a contact carrier having a plurality of movable contact elements which coact with the stationary contact elements and the resistance element to variably control the application of the electrical energy to the motor. A manually actuatable trigger handle is adjustably connected to the contact carrier to enable selective manual actuation thereof. The trigger handle is longitudinally adjustable on the contact carrier to enable the operator to preselect the amount the movable contaCts may be moved relative to the stationary contact elements and resistance element and thus control the speed of the motor.



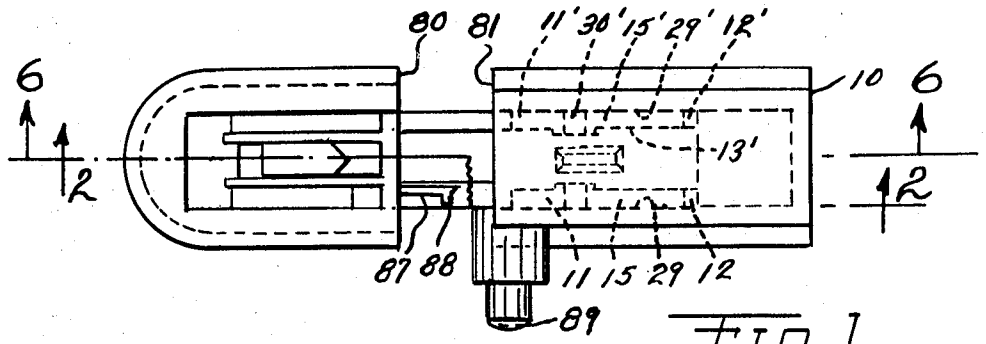


FIG. 1

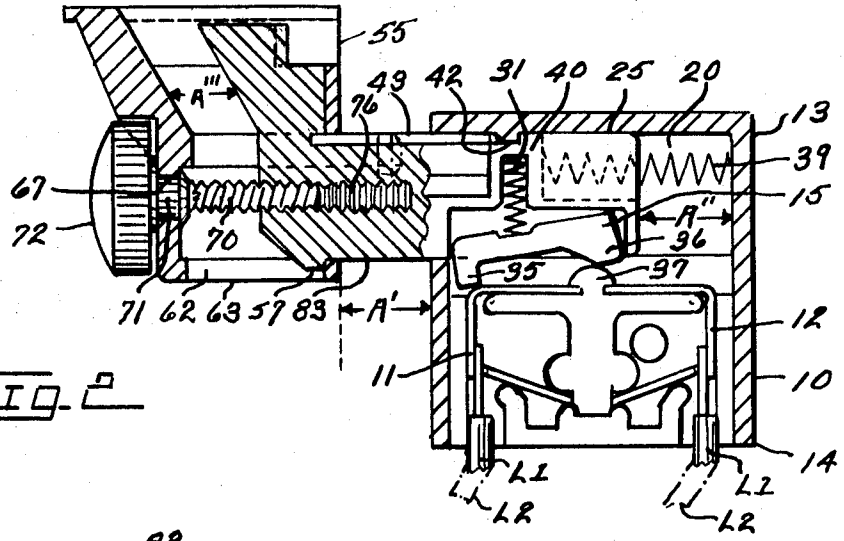


FIG. 2

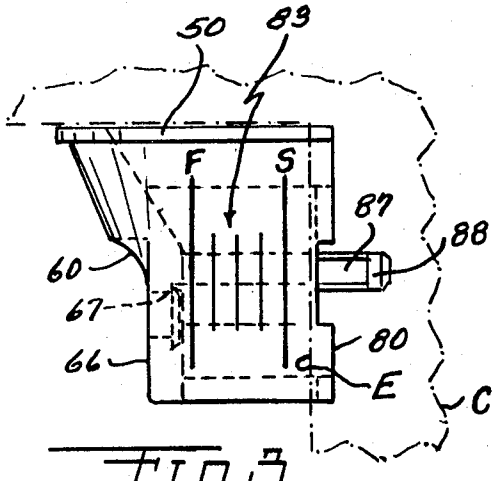


FIG. 3

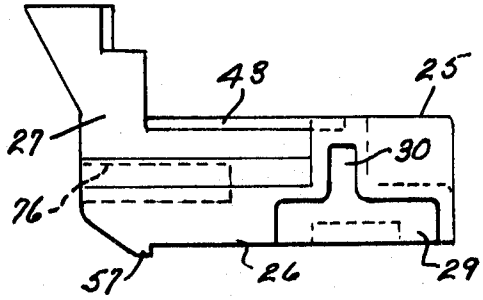


FIG. 4

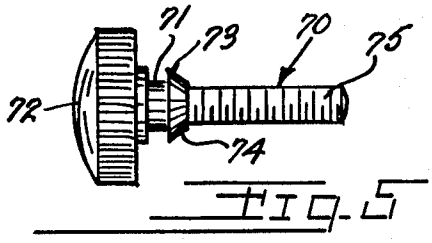
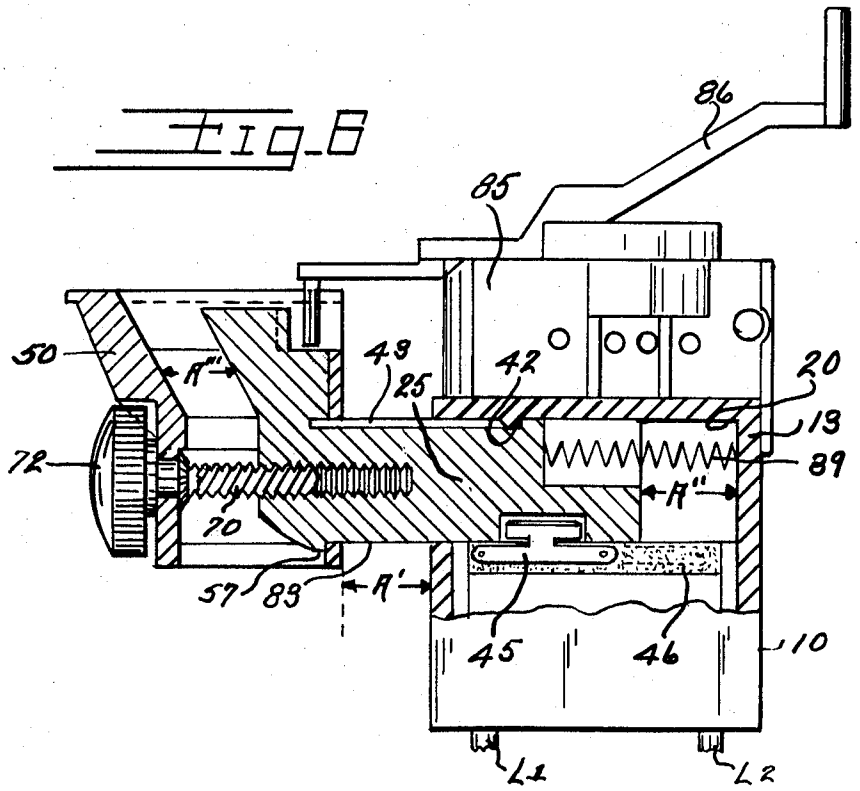


FIG. 5

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Fig. 6



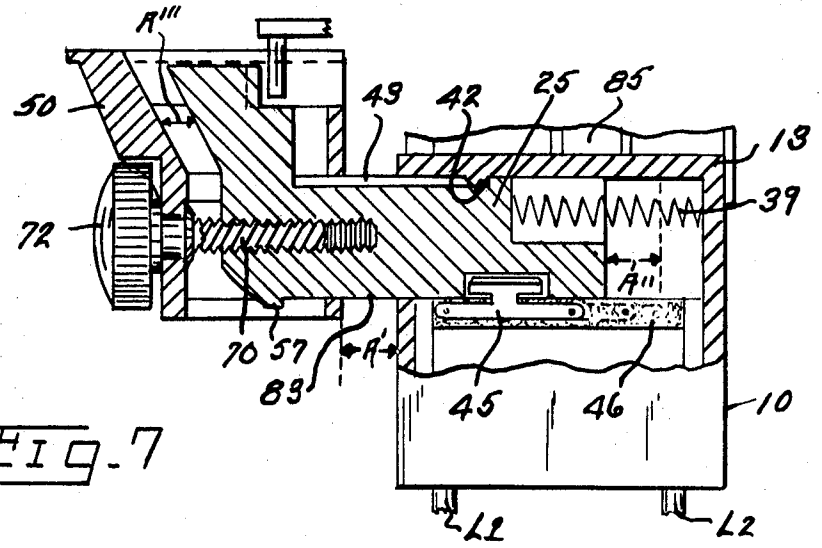


Fig. 7

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ADJUSTABLE SWITCH DEVICE

This invention relates generally to an electrical switch device and more particularly to an electrical switch device for portable electric motor-driven tools to control the application of electrical energy from an energy source to the motor and wherein the switch device is also manually adjustable to effect a preselected magnitude of electrical energy to be applied to the motor with the switch device in its full "on position."

There has long been a need for a simple, efficient, trigger-actuated switch for variably controlling the motor speed in portable electric tools and appliances such as, for example, an electric drill, food mixer and/or similar devices.

The switch device of the invention is intended to be connected in controlling relation with the appliance and the electrical energy source to which it is connected, as for example in the handle of the portable electric tool, so as to be conveniently actuated by the operator thereof to variably control the application of such energy to the motor of the tool.

It is therefore a primary object of the present invention to provide an electrical switch device for controllably varying the application of electrical energy from an energy source to a connected load such as an electrical appliance and which switch device is intended to be manually operable to controllably vary the application of said energy to the appliance.

Another object of the present invention is to provide a new and novel electrical switch device for controllably varying the application of electrical energy from an energy source to a connected load such as hand-held electric drill, food mixer or like appliance, and which switch is also adjustable to provide a predetermined magnitude of energy to be applied to the connected load when the switch device is in its full "on" position.

A further object of the invention is to provide a trigger-operated hand-drill switch having adjustable stop means for adjusting the stroke of the trigger.

A further object of the invention is to provide a portable-tool switch that is simple in construction, inexpensive to manufacture, and highly effective in operation.

Additional objects and advantages of the switch device of the present invention will be apparent to one skilled in the art to which it pertains and upon reference to the following description of a preferred embodiment thereof which is illustrated in the accompanying drawings wherein:

FIG. 1 is a top plan view of an electrical switch device embodying the present invention;

FIG. 2 is a vertical section of the switch device taken generally along the line 2—2 as shown in FIG. 1;

FIG. 3 is a side elevational view of the trigger handle or actuator element of the switch device shown in FIG. 2;

FIG. 4 is a side elevational view of the movable contact carrier or slide bar shown in FIG. 2;

FIG. 5 is a side elevational view of the adjustable setscrew for adjustably connecting the trigger element or handle and the contact carrier;

FIG. 6 is a side view shown partially in cross section and taken approximately on the line 6—6 of FIG. 1 and additionally showing an energy-reversing switch module and finger actuator mounted on top of the switch housing; and

FIG. 7 is a view similar to FIG. 6, but showing the trigger element in a different adjusted position.

Although the switch of the invention is shown and described herein with reference to its application in a portable electric drill it will be understood that it may be used in any application to variably control the application of electrical energy to an applied load.

The terms and expressions which have been employed 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 the features shown and described or portions thereof, but it is recognized that various modifications are possible within the scope of the invention claimed.

Referring now to the drawings, and the with particular reference to FIG. 2, the switch device of the present invention

includes a switch casing or body **10** which encases a switch mechanism or control system that is disclosed and claimed in the assignee's copending application Ser. No. 702,272 entitled Electric Switch and filed on Feb. 1, 1968, such mechanism including a pair of stationary contacts **11** and **12** corresponding to contacts **20** and **24** in said copending application. Certain portions of such switch mechanism will be described herein for a better understanding of the invention. The switch housing **10** includes an upper portion identified at **13** and a lower portion identified at **14**. The switching components are disposed in the lower portion of the housing **14** and are connectable into both sides of the electrical energy source of a two-line system and which are capable of simultaneously making and breaking the circuit in each of said lines. For example, as shown in FIG. **2**, there is a conductor line L1 which is broken so as to permit the insertion of switch contacts **11** and **12** in circuit therewith and, in like manner, conductor L2 is similarly broken so as to permit its being connected in similar fashion to a second group of stationary contacts **11'**, **12'** and **13'** corresponding to contacts **52**, **52***a* and **52***b* in said copending application and which are disposed on the **11'**, **12'** of **13'** housing so as to coact with a bridging contact of the type that is shown at **15**, later to be described.

Thus, the switching component includes basically spaced pairs of stationary contacts that are disposed in spaced relation to each other on either side of a centerline extending through to each other on either side of a centerline extending through the switch structure as is shown in FIG. **1**, one pair of stationary contacts being identified by the numerals **11** and **12** and the corresponding opposed group of stationary contacts being identified by the reference numeral **11'12'** and **13'** (FIG. **1**).

A bridging contact identified at **15** (and **15'**) coacts with the spaced stationary contacts **11**, **12** (and **11'**, **12'**, **13'**, respectively), being movable within the housing in a manner as will be hereinafter described to bridge across its associated stationary contacts, thus providing electrical conductivity therebetween.

Thus, as herein shown, the switch device is intended to be connected into both conductors of a two-line conductor electrical energy source, one such conductor or line being identified as L1 and the second conductor being identified as L2. Conductor L1 is seen to be broken and connected one end to each of the stationary contacts **11** and **12** of the one pair and conductor L2 is similarly broken and connected one end to each of the corresponding stationary contacts **11'** and **13'**.

As is also more thoroughly described in the aforesaid copending application Ser. No. 702,272, conductors L1 L2 shown in the right end portion of the switch housing, as shown in FIG. **2**, are connected across the electrical load (motor) to which the switch is to be operable, whereas the conductors L1 and L2 as shown in the left portion of the housing are connected to the electrical energy source, such lines being thus operable to connect the switch device between the energy source and the connected load.

As shown in FIG. **2**, the upper portion of the housing **13** defines a cavity or upper chamber **20** which, as shown in the instant embodiment, is somewhat rectangular in configuration and extends longitudinally of the housing **10**.

A slide actuator or contact carrier **25** as best seen in FIG. **4**, is reciprocably disposed within the upper chamber **20**, said actuator being somewhat L-shaped in configuration and having an elongated base leg **26** integrally formed with an upstanding vertical extending leg or outer portion **27**. The base leg **26** is formed with a pair of recesses **29**, **29'** into each of which is disposed one of the contact carrier or bridging contacts **15**, **15'**, respectively.

As shown in FIG. **4**, each recess **29**, **29'** is somewhat of inverted T-shaped configuration having an upstanding cavity portion **30**, **30'** into which is disposed a suitable spring member **31** which engages each bridging contact **15**, **15'** with sufficient force to urge said bridging contact into pressure engagement with its associated stationary contacts **11**, **12** and

11', 12', 13', respectively, to effect an electrical connection therebetween.

As heretofore mentioned, the contact carrier 25 is intended to be disposed within the housing chamber 20 and is of such dimension with respect thereto as to be freely slidable therein longitudinally throughout the chamber.

As best shown in FIG. 2, the contact carrier 25 is disposed so as to locate the bridging contact 15, with one end 35 thereof in pressure engagement with its associated stationary contact 11. The opposite contacting end 36 of the bridging contact 15, is shown to be resting upon the upper portion of a cam 37 formed integrally in the switch housing 10, such cam being operable to secure the stationary contacts into their operative position, in that the cam 37 is seen to be extendable over the contacting surface of the stationary contacts 11 and 12. The aforedescribed bridging contact-cam structure also applied to the bridging contact 15'.

From this FIG. 2 position, which may also hereinafter be referred to as the "off" position of the switch device, the slide actuator or contact carrier 25 may be moved to the right, whereupon the bridging contacts 15, 15' are carried to the right sufficiently to have the forward contacting end thereof slide downwardly over the cam 37 and into engagement with the upper surface of the stationary contacts 12 and 12', and subsequently with stationary contact 13'.

Variable control of the motor speed is effected by a slide 45 (FIG. 6) which is secured to the contact carrier 25 and which slides over the resistance strip 46 in operative contact therewith, as explained in detail in the above copending application Ser. No 702,272.

Thus, reciprocation of the contact carrier 25 in and out of the casing 10 selectively starts and stops the motor and controls the speed thereof.

As shown in FIG. 2, the distance that the slide actuator is capable of being moved into the chamber 20 is identified by the reference A.

The slide actuator is normally biased outwardly or to the left, as shown in FIG. 2, so as to be normally disposed in its "off" position. For this purpose, a suitable resilient or bias means in the form of a compressed coil spring 39 has its one end suitably engaging the inner surface of the upper portion of the housing 13 and its opposite ends in like engagement with wall 40 of the contact carrier 25, whereupon the latter is normally urged outwardly or to the left of the housing chamber 20 to a normally "off" position as shown in FIG. 2.

The upper wall of the housing 13 is provided with a downwardly depending boss or projection 42, which is disposed in a suitable elongated recess 43 (FIG. 4) which extends along the upper portion of the leg 26 of the contact carrier 25 and which recess terminates closely adjacent to the wall 40 of said contact carrier.

In its initial installation, the contact carrier 25 is inserted within the housing chamber 20. The housing is sufficiently flexible to permit the contact carrier to be forced therein until the depending boss or stop means 42 snaps into the elongated recess 43 being thus effective to capture the contact carrier within the housing chamber 20 and reciprocable therein. Thus, the stop means 42 prevents movement of the contact carrier 25 beyond (as to the left of) its extended position as shown in FIG. 2.

The instant switch assembly also includes a trigger handle 50 which is adjustably secured to the contact carrier 25 and is disposed so as to be operable by the trigger finger of the operator to slide the contact carrier into the housing chamber 20 and thus operate the electrical switch components therein.

FOr this purpose, and as best seen in FIG. 2, the trigger handle is somewhat rectangular in elevation, being formed with a cavity or opening 55 in its one end, such cavity slidably accommodating the vertical leg 27 of the contact carrier 25 and the adjoining connected portion of the leg 26 thereof.

Approximately at the point of juncture between the vertical leg 27 and the horizontal leg 26 of the contact carrier 25, a downwardly depending rib 57 is integrally formed therewith and is of such dimension to require the leg 27 to be forced with slight pressure into the trigger cavity 55 and to enable the rib 57 to enter into slot 62 formed centrally within the bottom wall 63 of the trigger element and which slot extends longitudinally therethrough. In this manner, the contact carrier 25 is snapped into the trigger handle 50 and, by reason of the rib 57 being disposed within the slot 62, is slidably captured therein so that the two elements are not separable.

The bottom portion 66 (FIG. 3) of the front wall 60 of the trigger 50 has an aperture 67 intended to accommodate an adjusting setscrew 70, as will now be described.

As best seen in FIG. 5, the adjusting setscrew 70 is provided with a smooth shank portion 71 formed adjacent its enlarged head portion 72, said shank 71 being formed on its opposite end with an enlarged boss 73 having a tapered outer wall 74 which tapers downwardly from the end adjacent the shank 71 to the threaded portion 75 thereof.

The adjustable setscrew 70 is intended to be operatively inserted within the hole 67 formed in the front wall 66 of the trigger 50, the trigger being formed of any suitable partially resilient material, whereby suitable pressure as applied to the enlarged head 72 forces the tapered boss 73 into the hole 67 sufficiently to temporarily deform the material defining said taper and said hole to the position wherein the adjusting screw snaps into place and is capture within the said front wall 66 whereupon the smooth shake portion 71 is disposed within the hole 67 and is of such dimension with respect thereto to be freely rotatable therein.

The setscrew threaded shake portion 75 is intended to be threadedly disposed within an internally threaded hole 76 formed in the adjacent portion of the base leg 26 of the contact carrier 25.

WIth this assembly, by rotating the engaged head 72 of the adjusting setscrew 70 sufficiently to threadedly move the threaded shake portion 75 thereof into and out of the internally threaded hole 76, the trigger 50 is slidably moved toward and away from the contact carrier 25. Thus, the setscrew 70 provides manually operable means for selectively moving the trigger handle longitudinally on the contact carrier 25.

The trigger 50 has an abutment 80 engageable with the casing 10 at the point 81 to limit movement of the contact carrier 25 into the casing and thereby selectively control the motor speed.

Specifically, the maximum adjustment distance between the trigger handle 50 and the contact carrier 25 is represented by the letters A' and A''' in FIGS. 2 and 6, and in such figures A'' represents the total distance the contact carrier can travel at such maximum adjustment. In FIG. 7, A' and A''' represent the minimum adjustment distance between the trigger handle 50 and the contact carrier 25, and in such figure A'' represents the distance the contact carrier can travel at such minimum adjustment.

It is oftentimes desirable to preset the switch so that upon its subsequent operation a preselected motor speed may be obtained.

For this purpose a scale identified at 83 is formed or scribed by any suitable method on the outer surface of the trigger handle 50, and is intended to cooperate with an edge E of the aperture formed in the handle of the tool casing C into which the switch is disposed.

As best seen in FIG. 3, the outer limits of the scale 83 are identified at F and S, F signifying a fast motor speed and S for slow motor speed.

As previously described, the trigger handle 50 may be adjustably moved longitudinally along the contact carrier 25 by turning the adjusting screw 70 in the appropriate direction. In this manner, the handle 50 may be preset into an adjusted position on the carrier 25 while the latter is in its off-switch position. In this position, the scale 83 will likewise be positioned with respect to said casing edge E to identify the expected motor speed to be obtained when the trigger handle 50 is depressed into the tool casing.

FIG. 6 shows a reversing switch 85 mounted on the casing 10 and having a handle 86 extending in a direction opposite to or rearwardly of the trigger handle 50. The operative details of such switches are described in U.S. Pat. No. 3,467,801.

The trigger handle 50 includes a longitudinally extending arm 87 having a sidewardly projecting lug 88 on the end thereof which is engaged by the outwardly biased pushbutton 89 to lock the trigger handle-contact carrier combination in "on" position as described in detail in the aforementioned application Ser. No. 702,272.

What is claimed is:

1. In a portable electric motor-driven tool having a trigger-receiving housing aperture, wherein the tool is of the type adapted to contain a control system capable of varying the speed of the tool motor in response to a predetermined amount of trigger movement, a trigger-actuated switch device for mounting in said aperture, said switch device comprising, a switch casing, an elongated contact carrier operatively connected to the control system and mounted for reciprocation in said casing to vary the motor speed with an outer portion of the contact carrier extending outwardly of the casing, bias means carried by the casing and engaged with the contact carrier for urging the same to an extended position, stop means for preventing movement of the contact carrier beyond such extended position, a separate and distinct trigger handle adjustably mounted on the outer portion of the contact carrier for selective longitudinal movement thereon, and manually operable means for selectively moving said trigger handle longitudinally on said contact carrier to predetermined positions thereon, said trigger having an abutment engageable with the casing to limit movement of the contact carrier into the casing and thereby selectively control the motor speed.

2. The structure of claim 1 wherein said manually operable means includes an adjustment screw rotatively disposed in said trigger handle and extending into the contact carrier in threaded engagement therewith, whereby preselected circumferential rotation of the adjustment screw varies the distance between the trigger handle and the contact carrier a predetermined amount thereby selecting a desired motor speed.

3. The structure of claim 1 wherein said bias means includes a compressed coiled spring disposed between the contact carrier and the casing.

4. The structure of claim 1 wherein said contact carrier has an elongated recess in its upper surface, and said casing has a projection extending into said recess to form said stop means.

5. The structure of claim 1 and further including a reversing switch mounted on said casing in coacting relation with said switch device, said reversing switch having a handle extending in a direction opposite and rearwardly of the trigger handle.

6. The structure of claim 1 wherein the trigger handle has a scale formed thereon and which coacts with the part of the housing defining the switch aperture to enable an operator to select a predetermined motor speed with the switch in its off position.