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3,205,466

MINIATURIZED VARIABLE RESISTOR AND SWITCH

Filed Dec. 13, 1961

3 Sheets-Sheet 1

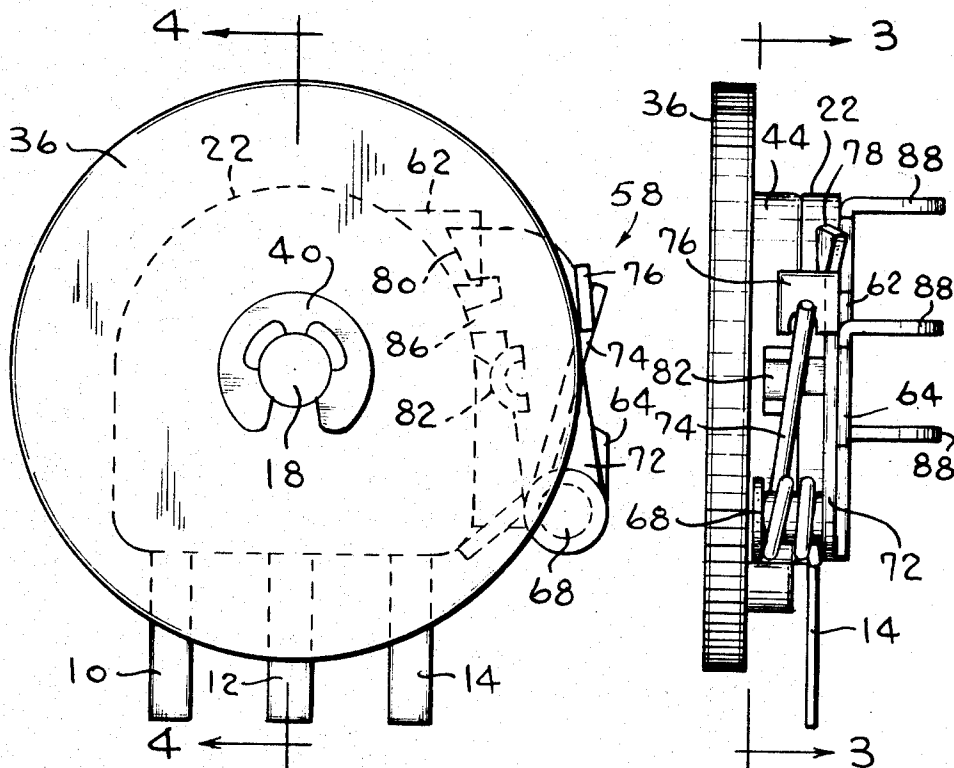


FIG. 1

FIG. 2

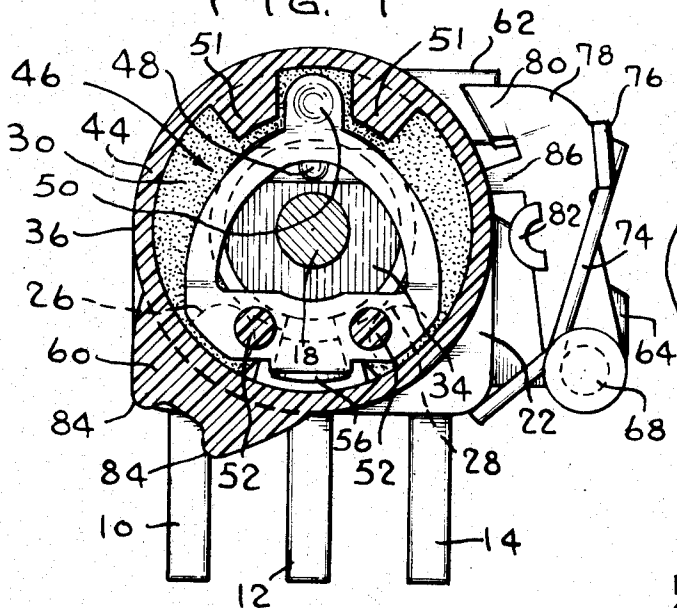


FIG. 3

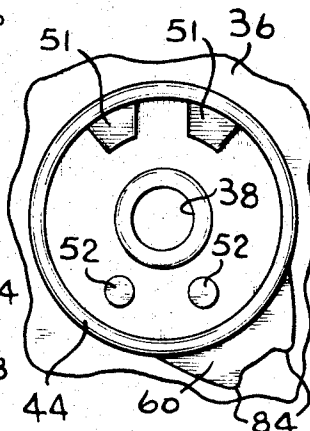


FIG. 9

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3 Sheets-Sheet 2

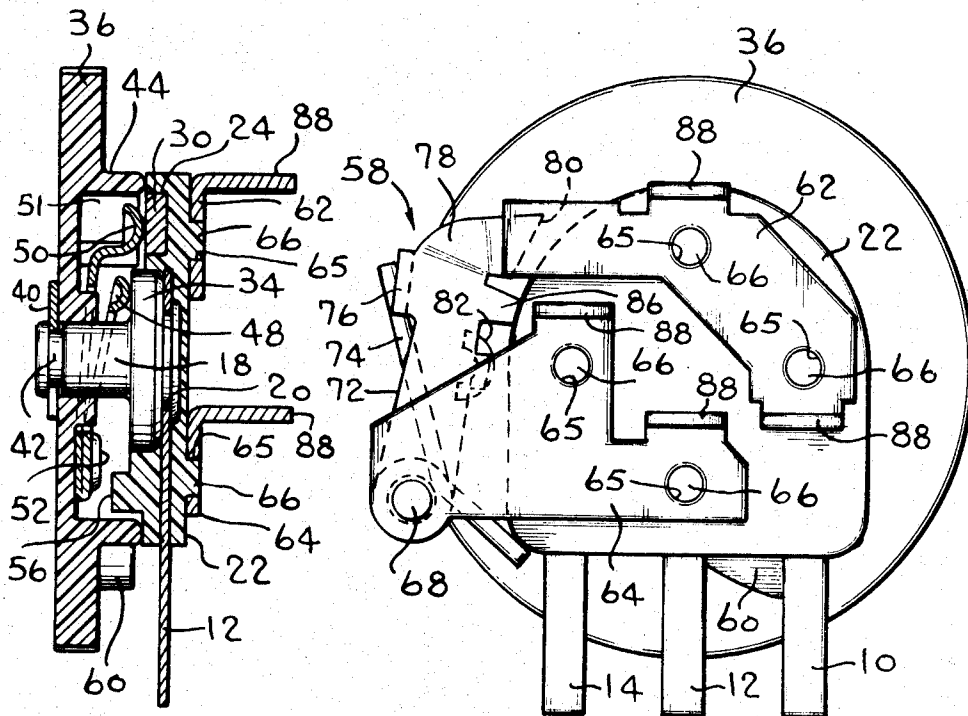


FIG. 4

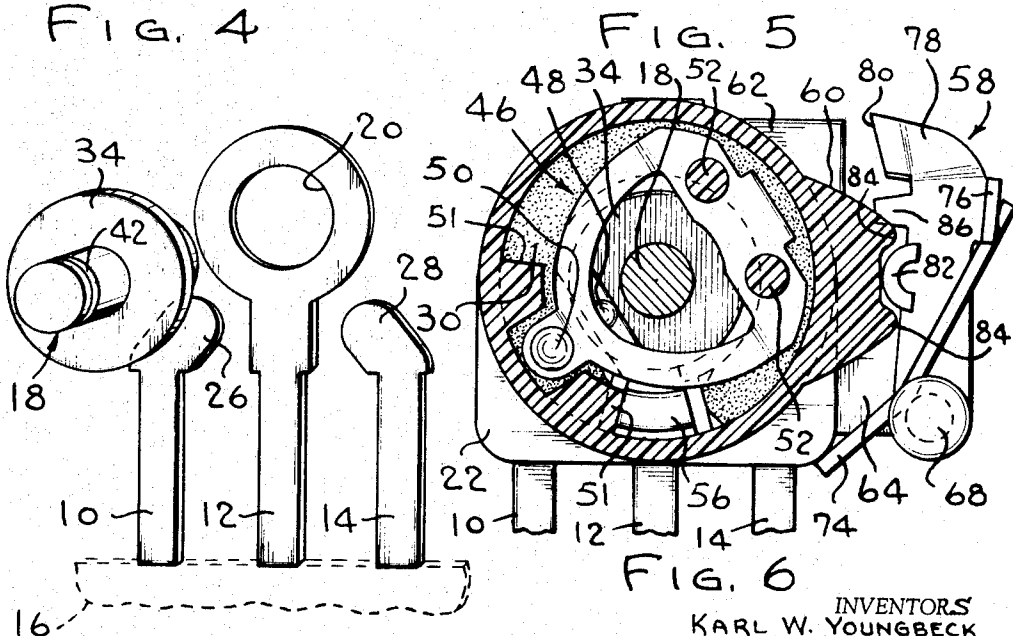


FIG. 5

FIG. 7

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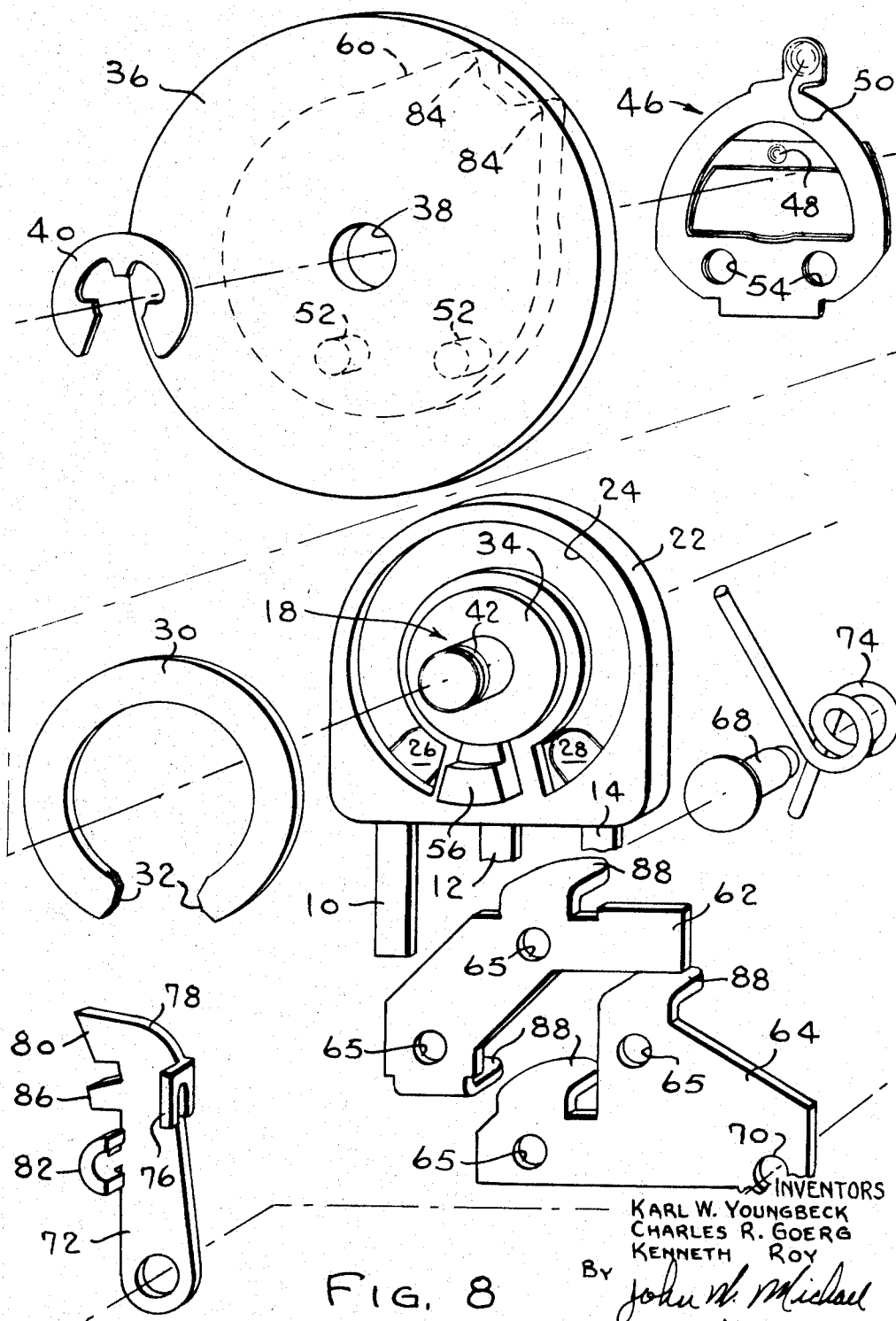
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3 Sheets-Sheet 3



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MINIATURIZED VARIABLE RESISTOR AND SWITCH

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3 Claims. (Cl. 338—163)

This invention relates to improved variable resistor and integral switch arrangements which are designed for use in miniature electrical devices such as hearing aids and pocket receivers.

Electrical devices which are used for these purposes must occupy a minimum of space and of necessity be self-cleaning. This is particularly true in the case of hearing aids where dust, lint, hair, perspiration deposits and other foreign substances are commonly encountered. Due to the extremely small size of the parts the proper relationship of the switch actuating cam, switch position and electrical contactor position is difficult to obtain without careful assembly procedures.

The primary object of the present invention is to provide an improved variable resistor and switch in which the switch is so arranged with respect to the variable resistor that it requires a minimum of space.

Another object is to provide an improved switch and variable resistor arrangement which provides a distinct "feel" when the switch is moved to the off position.

A further object is to provide an improved switch and variable resistor in which the switch is electrically quiet during the operation of the resistor.

Another object is to provide an improved variable resistor and switch which has relatively few parts.

Another object of the present invention is to provide an improved variable resistor and switch in which the relationship of the operating parts is determined by aligning members on the molded parts.

These objects are accomplished by molding an operating shaft and a number of electrical terminals into the variable resistor base. The operating shaft is secured to one of the terminals to provide a centrally disposed contact for the resistor. A resistance element is positioned in a groove provided on one side of the base in electrical contact with two of the other electrical contact with two of the other electrical terminals. A hollow operating knob is mounted on the shaft and slides on the surface of the base forming a sealed cavity around the resistance element. An electrical connector is carried by the operating knob to complete a circuit from the variable resistance element to the operating shaft. The resistance of the circuit is varied by rotating the operating knob on the shaft to slide the connector across the resistance element. A pair of flat switch terminals are secured to the back of the base and extend laterally outward therefrom. A switch blade is mounted on one of the terminals and is spring biased into wiping engagement with the other terminal to make electrical contact therewith. The switch blade is movable in the space between the plane of the switch terminals and the plane of the outside surface of the operating knob. A cam molded to the side of the operating knob is used to actuate the switch and is contoured to provide a positive feel when the switch is opened or closed. Locating the switch on the side of the base reduces the thickness of the resistor with a small increase in the width of the resistor. Actuating the switch by a cam located on the side of the operating knob reduces the number of parts to be assembled simplifying manufacture. The location of the electrical contactor with respect to the switch cam and the location of the switch terminals with respect to the limit stop are both determined during the molding of the base and operating knob thereby elim-

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inating the need for special assembly procedures in manufacturing the resistor.

The structural arrangement of the parts has made it possible to provide a variable resistor and switch having a thickness of approximately 0.120 inch and an overall diameter of approximately 0.50 inch exclusive of the electrical terminals. This reduction in size makes it possible to assemble the resistor and switch in electrical devices in a minimum of space.

Other objects and advantages will be pointed out in or be apparent from the specification and claims, as will obvious modifications of the single embodiment shown in the drawings, in which:

FIG. 1 is a front view of the switch;

FIG. 2 is a side view of the switch;

FIG. 3 is a vertical section view taken along line 3—3 of FIG. 2 with the switch closed and the knob in the central position;

FIG. 4 is a vertical section view taken along line 4—4 of FIG. 1 showing how the unit is held together by the retaining ring;

FIG. 5 is a back view of the switch;

FIG. 6 is a sectional view similar to FIG. 3 but the knob has been rotated counter-clockwise to the stop position and the switch is opened by the cam;

FIG. 7 is a perspective view of the contacts and center post before the center post is peened to the center contact;

FIG. 8 is an exploded view of the switch and also showing the center post and fixed contacts molded into the base; and

FIG. 9 is a fragmentary view of the back of the knob.

Referring to the drawings, the combined variable resistor and line switch includes terminals 10, 12, and 14 (FIG. 7) which are stamped from a flat strip of electrically conductive material with a common member 16 (shown dotted) left to support the terminals. An operating shaft 18 is inserted into hole 20 in the center terminal and permanently secured thereto by peening the end of the shaft. A base 22 is molded onto the terminals so that the operating shaft and terminals become an integral part of the base. The common member 16 is then cut off of the terminals. An arcuate groove 24 is provided on one face of the base with ends 26 and 28 of terminals 10 and 14 being flush with the bottom surface of the groove. A phenolic resistance element 30 is contoured to fit tightly in the groove and is secured therein by any suitable adhesive. The ends of the resistance element are silver tipped shown generally at 32 to provide a positive electrical connection between the resistance element and the electrical terminals.

The operating shaft has a flange 34 which is embedded in the base with one surface of the flange raised slightly above the surface of the base to prevent molding flash and exposed to form a contact surface. A molded plastic operating knob 36 is mounted on the base by inserting the end of the operating shaft through hole 38 in the operating knob and snapping retaining ring 40 into groove 42 in the operating shaft. The operating knob has a large diameter finger engaging portion and an annular flange 44 of smaller diameter. The annular flange 44 is molded integral with the knob and engages the outer edge of the base around the perimeter of groove 24 to form a cavity between the operating knob and the base. The flange has a depth slightly greater than the distance from groove 42 to the face of the base so that the center of the knob is bent slightly to allow room for the retaining ring which will bias the flange against the face of the base forming a seal therewith to keep the cavity free of foreign material as enumerated above.

The resistance element and flange of the operating shaft are electrically connected by contactor 46 which is stamped from an electrically conductive flat strip and

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bent to form two wiping contacts 48 and 50. The contactor is mounted on the operating knob by heat sealing posts 52 in holes 54 and the contactor is bent so that the electrical contacts are biased into engagement with the surface of the shaft flange and resistance element. The contactor and operating knob can be rotated in either direction until one or the other of limit stops 51 abuts stop 56 molded integral with the face of the base midway between the ends of the resistance element.

A line switch shown generally at 58 is provided on one side of the base in the horizontal plane of the base and is actuated by a cam 60 molded on the outer surface of the flange on the operating knob. The cam is positioned to open the line switch when contact 50 is near one end of the resistance element (FIG. 6) and will not engage the switch in any other position of the operating knob. The line switch includes a flat stationary terminal 62 and a flat pivot terminal 64 both of which are secured to the back surface of the base. The switch terminals can be mounted at 90°, 180°, and 270° with respect to the resistance element. Locating nibs 66 may be provided on the back of the base to engage holes 65 and align the terminals on the base if desired. A pivot post 68 is mounted in hole 70 in the pivot terminal and supports a switch blade 72 for rotary motion into engagement with the stationary terminal. The switch is biased to a closed position by spiral spring 74 which has one end abutting the side of the base and the other end biased into engagement with tab 76 bent downward from the plane of the blade. End 78 of the switch blade is bent slightly outward from the plane of the blade and tip 80 of the switch blade bent inward to provide a positive wiping contact surface between the switch blade and fixed contact which is self-cleaning.

The switch blade is actuated by a cam formed on the outer surface of the flange 44 and not extending beyond the outer periphery of the operating knob. This cam engages a cam follower 82 bent downward from the plane of the blade. The cam has fast dropping cam surfaces 84 on its outer surface to provide a positive "feel" when the blade is moved from the open to the closed position. An overtravel tab 86 is provided on the switch blade to engage the surface of the base thereby preventing overtravel of the switch blade. Mounting tabs 88 may be provided on the terminals 62 and 64 if required for mounting the variable resistor on an electrical device.

The depth of the small diameter annular flange 44 combined with the depth of the base 22 is just sufficient to accommodate the pivot post 68, the spring 64, and the switch blade 72. Thus, the switch may lie beneath the large diameter finger engaging portion of the operating knob.

It should be noted that all of the electrically conductive parts are stamped from flat stock material and bent where necessary in a single operation simplifying manufacturing considerably. The location of the switching blade in the plane of the base has reduced the thickness of the resistor without materially increasing its width. This also makes it possible to provide the switch actuating cam surface on the side of the operating knob with the aligning posts for both the electrical contactor and switch terminals molded thereon to insure the accurate location of all the parts.

Although but a single embodiment of the present invention has been illustrated and described, it will be apparent to those skilled in the art that various changes and modifications may be made therein without departing from the spirit of the invention or from the scope of the appended claims.

We claim:

1. The combination of a miniaturized variable resistance device with a snap-feel on and off switch both operated by the same manually operable rotatable control comprising,

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a molded base providing a common support for the resistance device and the switch, said base having a flat back surface,

a flat stock stationary terminal secured to said flat back surface, said stationary terminal having a portion projecting laterally from the side of said base to provide a switch blade contact surface which lies in the plane of said back surface,

a flat stock pivot supporting terminal secured to said flat back surface, said pivot supporting terminal having a portion projecting laterally from the side of said base to provide a flat bearing surface for a switch blade, said bearing surface lying in the plane of said back surface,

a switch blade pivoted to said pivot supporting terminal having its swinging end angled from the plane of the blade to provide a sloping surface for engaging the edge and surface of the switch blade contact surface on said stationary terminal with a wiping action, said blade having a tab which projects towards and engages said base to fix the closed position of said blade, said blade having a cam follower which is spaced from the side of said base in the closed position of said switch,

spring means continuously urging said switch blade inwardly toward said base and into engagement with said contact surface of said stationary terminal, and

a molded operating knob rotatably carried by said base for operating the resistance device, said knob having a large diameter finger engaging portion and an annular flange of smaller diameter, spaced from said tab in the closed position of said switch, said smaller diameter flange being of a depth sufficient to permit said terminals, switch blade and spring to lie beneath said finger engaging portion, said annular flange having a cam molded on the outer surface thereof provided with a sharply inclined surface, a peak and a switch open seat, said cam engaging said cam follower to move said switch blade into open position as said knob is rotated in one direction, said cam follower sliding over said peak and down into said switch open seat with a snap-off feel, said cam follower riding over said peak and down said sharply inclined surface to let said blade snap into closed position with a snap-on feel upon rotation in the opposite direction.

2. The combination of a miniaturized variable resistance device with a snap-feel on and off switch, both operated by the same manually operable rotatable control comprising,

a molded base providing a common support for the resistance device and switch, said base having a flat back surface provided with four locating nibs equally angularly spaced with respect to the axis of rotation of the control,

a flat stock stationary terminal having a pair of holes spaced to fit over any two adjacent nibs and secured to said flat surface, said stationary terminal having a portion projecting laterally from the side of said base to provide a switch blade contact edge and surface which lies in the plane of said back surface,

a flat stock pivot supporting terminal having a pair of holes spaced to fit over any two adjacent nibs secured to said flat back surface, said pivot supporting terminal having a portion projecting laterally from the side of said base to provide a flat bearing surface for a switch blade, said bearing surface lying in the plane of said back surface,

a switch blade pivoted to said pivot supporting terminal having its swinging end angled from the plane of the blade to provide a sloping surface for engaging the edge and surface of the switch blade contact surface on said stationary terminal with a wiping action, said blade having a tab which projects towards and engages said base to fix the closed position of said blade, said blade having a cam follower which

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is spaced from the side of said base in the closed position of said switch,
 spring means continuously urging said switch blade inwardly towards said base and into engagement with said contact surface of said stationary terminal, and
 a molded operating knob rotatably carried by said base for operating the resistance device, said knob having a large diameter finger engaging portion and an annular flange of smaller diameter spaced from said tab in the closed position of said switch, said smaller diameter flange being of a depth sufficient to permit said terminals, switch blade and spring to lie beneath said finger engaging portion, said annular flange having a cam molded on the outer surface thereof provided with a sharply inclined surface, a peak and a switch open seat, said cam engaging said cam follower to move said switch blade into open position as said knob is rotated in one direction, said cam follower sliding over said peak and down into said switch open seat with a snap-off feel, said cam follower riding over said peak and down said sharply inclined surface to let said blade snap into a closed position with a snap-on feel upon rotation in the opposite direction.

3. A miniaturized electrical control device comprising, a molded insulating base,

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variable resistance means mounted on one side of said base,
 an electrically conductive shaft molded in said base having a flange adapted to be contacted by an electrical contactor,
 an operating knob rotatably mounted on said shaft, a pair of spaced posts projecting from said knob, and a spring type contactor formed from a single strip of material and folded back on itself to provide two wiping contacts connected to said operating knob, a pair of spaced openings in the folded over portion of said contactor through which said posts project, both of said posts having the outer ends thereof heat sealed over said contactor to rigidly mount said contactor to said operating knob,
 one of said wiping contacts being in wiping engagement with said variable resistance means and the other of said wiping contacts being in engagement with said flange.

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