May 14, 1968 J. M. VANANZI ET AL 3,383,635

VARIABLE RESISTOR

Filed Nov. 13, 1967

Fig. 1.

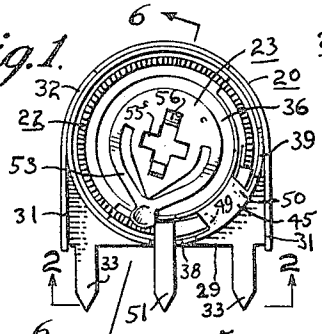


Fig. 2.

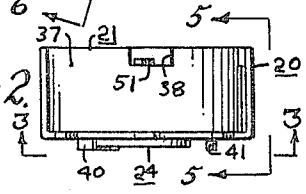


Fig. 3.

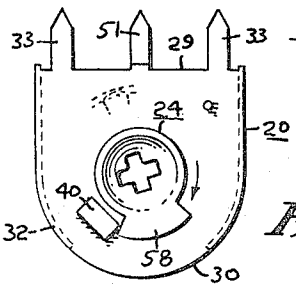


Fig. 4.

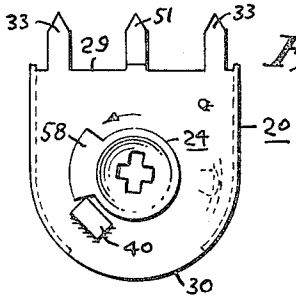


Fig. 8.

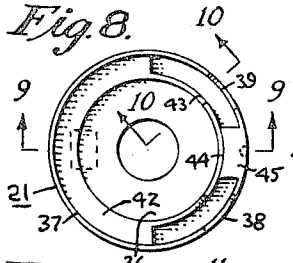


Fig. 9.

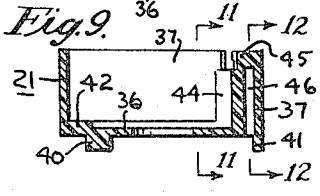


Fig. 13.

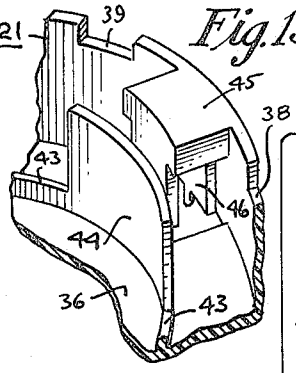


Fig. 14.

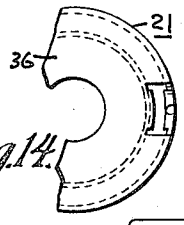


Fig. 10.

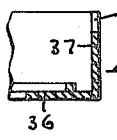


Fig. 11.

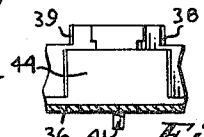
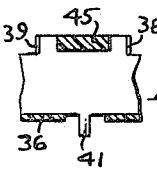


Fig. 12.



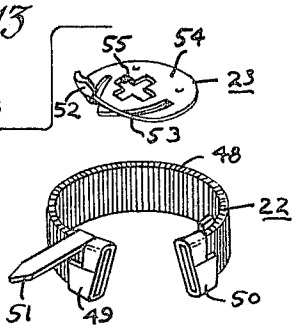
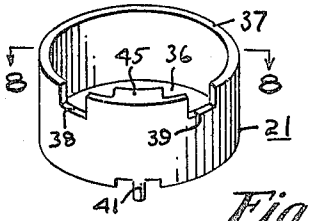


Fig. 7.



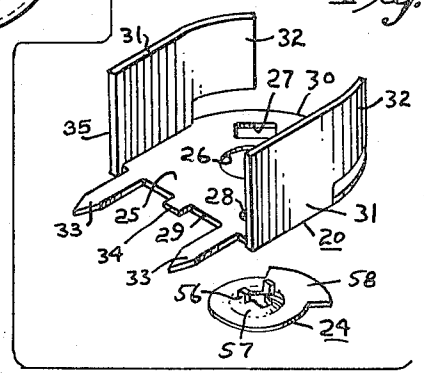


Fig. 5.

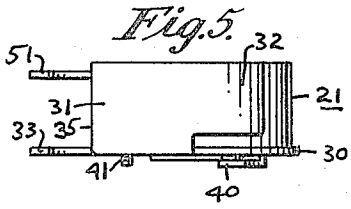
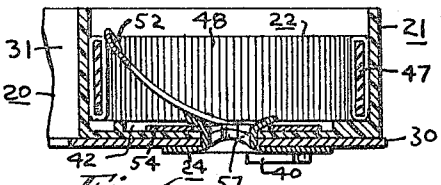


Fig. 6.



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# VARIABLE RESISTOR

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9 Claims. (Cl. 338—162)

## ABSTRACT OF THE DISCLOSURE

A variable resistor having an open faced housing, an insulating liner fitted and detented to the housing, a resistance element with end terminals detented in the liner, and a contact rotor engaged with the resistance element, all of the foregoing parts being held together by a locking plate having tabs projected through the housing and liner and rotor and turned outward to prevent withdrawal. The locking plate electrically connects the rotor to the housing and the latter is provided with circuit contact legs. A detent projection from the liner extends through a housing wall and in conjunction with an extension on the locking plate provides rotation stops for the contact rotor.

This invention relates to variable electrical resistance devices. The variable resistor according to the invention embodies a number of novel features which cooperate to provide an electrically reliable, mechanically rugged unit of relatively low cost which may be easily and quickly assembled by comparatively unskilled personnel. A novel aspect of the variable resistor according to the invention resides in a resistance element and a cooperating insulating liner which are disposed within a housing and held in mechanically stabilized position by a novel interlocking and detenting arrangement which does not require rivets, cementing or other permanent type securement. Accordingly, it is a primary object of this invention to provide a novel variable resistor incorporating the aforedescribed features.

Another object of this invention is to provide a novel variable resistor which incorporates a one-piece molded plastic liner detented within and secured to the cover shell or housing.

Yet another object of the invention is to provide a novel variable resistor as aforesaid in which the detenting structure of the plastic liner also functions as an end stop element for the movable contact of the variable resistor.

The foregoing and other objects of the invention will become apparent from a reading of the following specification in conjunction with an examination of the appended drawings wherein:

FIGURE 1 is a top plan view of the assembled variable resistor according to the invention;

FIGURE 2 is a front end elevation of the assembled resistor of FIGURE 1 as would be seen when viewed along the line 2—2 thereof;

FIGURE 3 is a bottom plan view of the variable resistor according to the invention as would be seen when viewed along the line 3—3 of FIGURE 2, the rotor positioning and locking plate being shown at one end of its adjusted position;

FIGURE 4 is a view similar to that of FIGURE 3 but showing the rotor positioning and locking plate in its extreme oppositely rotated position;

FIGURE 5 is a side elevational view of the variable resistor according to the invention as would be seen when viewed along the line 5—5 of FIGURE 2;

FIGURE 6 is a vertical section through the variable resistor according to the invention as would be seen when



viewed along the line 6—6 of FIGURE 1, the showing being on an enlarged scale;

FIGURE 7 is an exploded perspective view of the five basic parts which together constitute the variable resistor according to the invention;

FIGURE 8 is a top plan view of the insulating liner which is one component of the assembly, as would be seen when viewed along the line 8—8 of FIGURE 7;

FIGURE 9 is a vertical sectional view through the insulating liner of FIGURE 8 as would be seen when viewed along the line 9—9 thereof;

FIGURE 10 is a vertical fragmentary sectional view through the insulating liner of FIGURE 8 as would be seen when viewed along the line 10—10 of that latter figure;

FIGURES 11 and 12 are fragmentary vertical sectional views through the insulating liner of FIGURE 8 as would be seen when viewed along the lines 11—11 and 12—12 of FIGURE 9;

FIGURE 13 is an enlarged fragmentary view of a portion of the insulating liner in the region where the ends of the resistor element are received and captured; and

FIGURE 14 is a fragmentary bottom plan view of the insulating liner shown in top plan in FIGURE 8.

In the several figures, like elements are denoted by like reference characters.

Referring first to FIGURES 1, 2 and 5 to 7, the gross aspects of the variable resistor according to the invention as disclosed therein comprise a cover shell or housing 20, an insulating liner 21 embraced by the housing 20, a resistance element 22 captured within the insulating liner 21, a contact rotor 23 and an assembly locking plate 24 which also functions as a rotor stop device.

The cover shell or housing 20 is preferably made from a conductive material such as a metal stamping because it functions as the electrical connection for the contact rotor 23 as will be seen. The housing 20 has a main wall 25 substantially centrally circularly apertured as at 26, and provided also with detenting apertures 27 and 28 which cooperate with parts of the insulating liner 21 to positionally detent the latter as will be seen. The main wall 25 has a generally straight bottom edge 29 and a curved upper edge 30, with a pair of side walls 31 turned upward at right angles to the plane of the main wall 25 and being joined to the latter along its straight side edges from just below the straight bottom edge 29 toward the curved upper edge 30 to the point where the curvature of the main wall commences. The upper ends 32 of the side walls 31 are unsecured to the main wall 25 and follow the curvature of the curved upper edge 30 of the main wall for a substantial distance toward the top edge of the main wall but stop short thereof and do not meet. Extending longitudinally in plane with the main wall 25 and parallel to and spaced just laterally inward from the side walls 31 are a pair of contact legs 33, these legs being adapted typically for projection through holes of a circuit card or circuit board for soldered connection thereto. Extending centrally just slightly below the bottom edge 29 of the housing main wall 25 is a short leg 34 which has its lower edge in plane with the bottom edges 35 of the side walls 31.

As best seen from FIGURES 7 to 14, the insulating liner 21 is preferably made of molded plastic material. The gross structure of the liner 21 includes a circularly centrally apertured base wall 36 from which extends perpendicularly a generally cylindrical annular wall 37 having a wall depth substantially the same as the height of the housing side walls 31, the upper edge of the wall 37 being recessed downward as at 38 and 39 to provide passageways for the terminal legs of the resistance element

which may be used with the liner. Extending downward from the underside of the liner base wall 36 are detenting projections 40 and 41 which fit respectively through apertures 27 and 28 of the housing main wall 25 when the liner base wall 36 is seated flatwise downward upon the housing main wall 25 to provide anti-rotation detents which maintain the housing and liner in an exactly related position. The liner detenting projection 40 also functions, as will be seen, as a rotation stop for the contact rotor 23.

Extending upward from the base surface 36 and peripherally about the rear half of the liner is a narrow shelf or ledge 42 upon which the wound portion of the resistance element 22 rests. The inner periphery 43 of the shelf or ledge 42 extends forward completely about the base wall 36 but the ledge 42 itself is recessed down to the surface of the base wall 36 in the forward portions of the liner to provide room for the resistance element terminal securements. Extending upward from the ledge line inner periphery 43 in the region between the recesses 38 and 39 of the cylindrical outer annular wall 37 is an annular wall section 44 concentric with the outer annular wall 37 but at a smaller radius. Securing the upper central part of the wall section 44 to the portion of the annular wall 37 between the recesses 38 and 39 is a top bridging wall 45, so that a short tunnel 46 is thereby formed between the facing wall portions 37 and 44, this being best seen in FIGURES 9 and 13. As will be described, the opposite ends of the resistance element 22 are captured in the opposite ends of the tunnel 46.

As best seen in FIGURES 6 and 7, the resistance element 22 comprises a flat strip of flexible insulating material, such as plastic, configured in the form of a split cylindrical annulus 47. Wound about the annulus 47 is a continuous length of resistance wire 48 the opposite ends of which terminate proximate the ends of the annulus 47 and being there secured in place by the clamping action of end terminations 49 and 50. Each of the end terminations is a metal strap disposed closely about the resistance wire 48 and annulus 47 so as to clamp the latter therewithin and being fixedly secured by pressure clamping.

Turned outward from the upper edge of end termination 49 is a terminal leg 51 similar in shape to the contact leg 33 of the housing 20 and of a length comparable to the latter when the resistance element is installed in operative position in the completed variable resistor. The end termination 50 is not provided with a terminal leg 51 in the illustrated form of variable resistor, but could be so provided when used with a housing in which the detent apertures 27 and 28 were in a rotated position to permit a contact terminal extending from the end termination 50 to clear the housing side wall 31, it being observed from the showing of FIGURE 1 that this would not be the case in the illustrated embodiment.

The end surfaces of the end terminations 49 and 50 are straight line tapered from top to bottom so that when sprung together the top edges would contact one another while leaving a gap at the lower edges, this tapered end construction being utilized to provide a camming action against the bridging wall 45 of the insulating liner 21 to cause these ends of the resistance element 22 to snap into the tunnel 46 in the liner as the ends are pressed downward alongside of the side edges of the bridging wall 45 until they clear thereunder and snap into the tunnel 46. As best seen in FIGURES 1 and 2, with the resistance element so installed, the terminal leg 51 is disposed within and projecting through the recess 38 in the annular wall 37 and is parallel to the housing legs 33.

As best seen from FIGURES 1, 6 and 7, the rotor contact is stamped from a piece of resilient spring metal to provide a generally circularly shaped disc form from which laterally projects the contact finger 52, a generally C-shaped region being removed from the main body of the spring metal to provide a pair of arcuate arms 53 which connect the contact finger 52 to the main body 54 of the spring metal. The central region of the main body 54 is cross-punched as at 55 to receive the locking tabs 56 turned up out of the locking plate 24, the assembled interlocked structures being best seen in the cross sectional view of FIGURE 6.



FIGURES 6 and 7 illustrate the extremely simple assembly procedure for the variable resistor according to the invention, the assembly proceeding in the following way. The resistance element 22 is first snapped into the insulating liner 21 in the manner previously described. This sub-assembly is then assembled to the housing 20 by projecting the insulating liner base projections 40 and 41 through the detent apertures 27 and 28 of the housing. Next, the contact rotor 23 is placed inside the insulating liner with its contact finger 52 in operative engagement with the resistance element 22, and the locking plate 24 is placed against the outer surface of the housing main wall 25 with its locking tabs 56 projecting through the housing central circular aperture 26 and through the cross-punch 55 in the contact rotor 23. The locking tabs 56 are then turned outward as is best seen in FIGURE 6 to thereby secure all of the parts together in operative relationship. The locking plate 24 is provided with a central depression 57 which maintains the contact rotor 23 centrally located and laterally stabilized.

Additionally, as is best seen in FIGURES 3, 4 and 7, the locking plate 24 is further formed with a radially projecting sector part 58 whose radial extent is such that its opposite side edges abut the insulating liner projection 40 when the locking plate 24 and rotor 23 are rotated in such manner as to bring the contact finger 52 to opposite ends of the resistance element 22. It will of course be appreciated that any desired degree of adjustable rotation less than the maximum available can be provided as desired by controlling the angular extent of the sector 58 on the locking plate 24.

Having now described our invention in connection with a particularly illustrated embodiment thereof, it will be recognized that modifications and variations of the invention may occur from time to time to those persons normally skilled in the art without departing from the essential scope or spirit of our invention, and accordingly it is intended to claim the same broadly as well as specifically as indicated by the appended claims.

What is claimed to be new and useful is:

1. A rotary variable resistance unit comprising in combination, a housing closed at one end and open at the other end, said housing closed end being substantially centrally apertured and provided with detent means, an insulating liner having a centrally apertured base wall disposed against the inner side of said housing closed end and having a generally cylindrical annular wall extending substantially orthogonally from said base wall in the direction of the housing open end, detent means carried by said insulating liner and in detenting engagement with said housing detent means to thereby hold the housing and insulating liner locked against relative rotation, a split annular resistance element assembly disposed within and having opposite end terminations held captive by said insulating liner, a centrally apertured contact rotor having a movable contact finger in wiping contact with the said resistance element for movement along the latter by rotary movement of said rotor, and a locking plate disposed against the outer side of said housing closed end and having locking means extending through the central apertures of said housing and insulating liner and contact rotor which secures all of said parts together as an operative unit, said locking plate and contact rotor being interlocked for rotation together.

2. A variable resistance unit as defined in claim 1 wherein said housing, said contact rotor and said locking plate are electrically conductive and said locking plate electrically connects said contact rotor to said housing, said housing having at least one contact leg extending therefrom and suitable for use as an electrical terminal in electrical circuitry.

3. A variable resistance unit as defined in claim 1 wherein said insulating liner is formed of molded plastic material and said detent means carried thereby comprises a projection molded integrally with said liner and extending from the surface of said liner base wall which is disposed against said housing closed end, and wherein said housing closed end detent means comprises an opening shaped to receive said liner detent projection.

4. A variable resistance unit as defined in claim 1 wherein said insulating liner is formed of molded plastic insulating material and said detent means carried thereby comprises a projection molded integrally with said liner and extending from the surface of said liner base wall which is disposed against said housing closed end, wherein said housing closed end detent means comprises an opening shaped to receive said liner detent projection, said liner detent projection being longer than the thickness of said housing closed end so that said projection extends through and beyond said housing closed end, and wherein said locking plate includes a sector part extending radially outward beyond the point where said liner detent projection passes through said housing closed end, the angular extent of said sector part being such that opposite side edges thereof abut said liner projection when said rotor is rotated in opposite directions through a predetermined angle to thereby function as a rotor stop.

5. A variable resistance unit as defined in claim 1 wherein said insulating liner is provided with an annular wall section concentric with and spaced inward from said cylindrical annular wall and connected to the latter by a bridging wall section to thereby conjointly form a short tunnel open at opposite ends, the length of said split annular resistance element being somewhat greater than the free periphery of said cylindrical annular wall between the opposite free side edges of said bridging wall at opposite ends of said tunnel, the ends of said resistance element end terminations being tapered from top to bottom in opposite directions to form camming surfaces engageable against the free side edges of said tunnel when said resistance element is disposed peripherally about the inside surface of said liner cylindrical annular wall, whereby said resistance element is captured in said liner by forcing the end terminations downward until they snap into opposite ends of said tunnel.

6. A variable resistance unit as defined in claim 2 wherein said insulating liner is formed of molded plastic insulating material and said detent means carried thereby comprises a projection molded integrally with said liner and extending from the surface of said liner base wall which is disposed against said housing closed end, wherein said housing closed end detent means comprises an opening shaped to receive said liner detent projection, said liner detent projection being longer than the thickness of said housing closed end so that said projection extends through and beyond said housing closed end, and wherein said locking plate includes a sector part extending radially outward beyond the point where said liner detent projection passes through said housing closed end, the angular extent of said sector part being such that opposite side edges thereof abut said liner projection when said rotor is rotated in opposite directions through a predetermined angle to thereby function as a rotor stop.



7. A variable resistance unit as defined in claim 2 wherein said insulating liner is provided with an annular wall section concentric with and spaced inward from said cylindrical annular wall and connected to the latter by a bridging wall section to thereby conjointly form a short tunnel open at opposite ends, the length of said split annular resistance element being somewhat greater than the free periphery of said cylindrical annular wall between the opposite free side edges of said bridging wall at opposite ends of said tunnel, the ends of said resistance element end terminations being tapered from top to bottom in opposite directions to form camming surfaces engageable against the free side edges of said tunnel when said resistance element is disposed peripherally about the inside surface of said liner cylindrical annular wall, whereby said resistance element is captured in said liner by forcing the end terminations downward until they snap into opposite ends of said tunnel.

8. A rotary variable resistance unit as defined in claim 5 wherein said cylindrical annular liner wall is recessed downward from its free edge at two regions spaced apart on opposite sides of said tunnel to each provide a clearance path for an electrical terminal extended from an end termination of said resistance element.

9. A variable resistance unit as defined in claim 7 wherein said insulating liner is formed of molded plastic insulating material and said detent means carried thereby comprises a projection molded integrally with said liner and extending from the surface of said liner base wall which is disposed against said housing closed end, wherein said housing closed end detent means comprises an opening shaped to receive said liner detent projection, said liner detent projection being longer than the thickness of said housing closed end so that said projection extends through and beyond said housing closed end, and wherein said locking plate includes a sector part extending radially outward beyond the point where said liner detent projection passes through said housing closed end, the angular extent of said sector part being such that opposite side edges thereof abut said liner projection when said rotor is rotated in opposite directions through a predetermined angle to thereby function as a rotor stop.


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