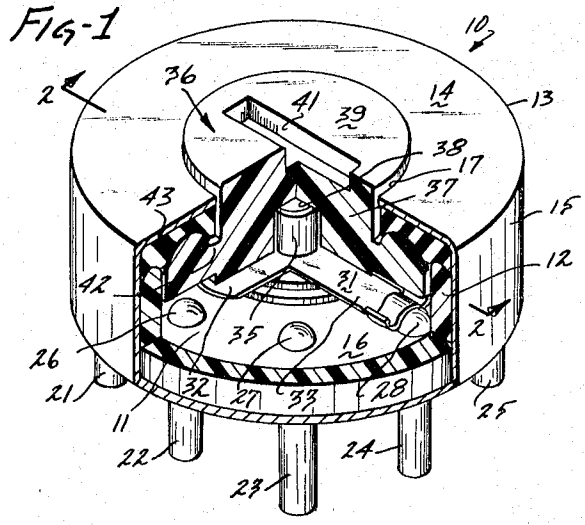
Feb. 27, 1968 G. SOULAKIS, JR 3,371,167

MINIATURE ROTARY SWITCH WITH CONTOURED CONTACTS

Filed Dec. 13, 1965

FIG-1



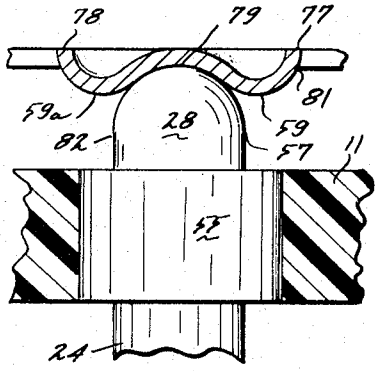


FIG-4

FIG-2

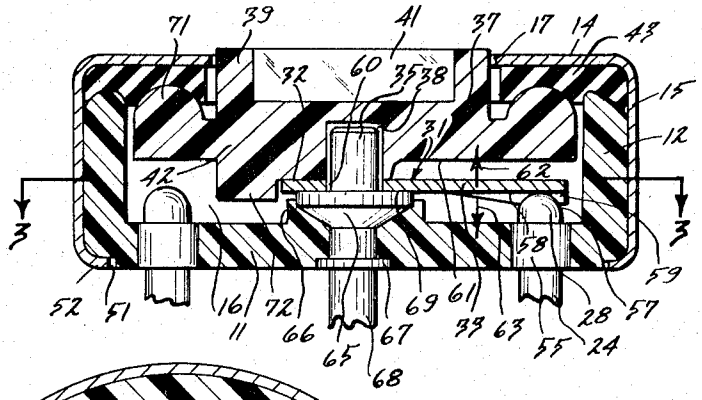
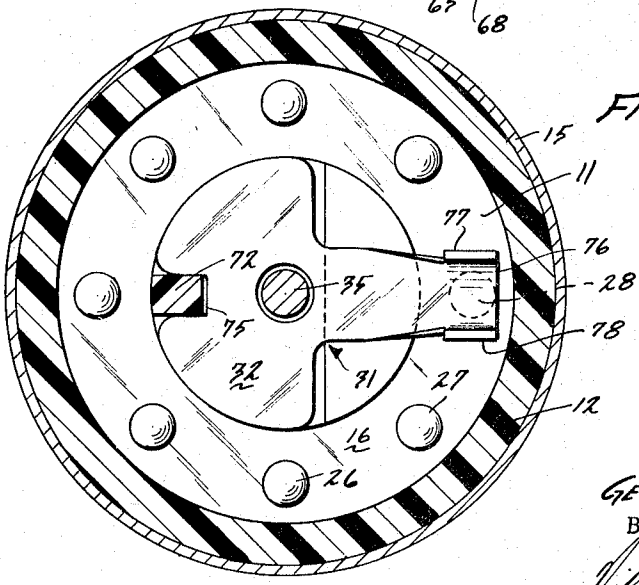


FIG-3



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MINIATURE ROTARY SWITCH WITH CONTOURED CONTACTS

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ABSTRACT OF THE DISCLOSURE

Disclosed is a miniature rotary switch having a plurality of discrete positions contactable by a movable contact member connected to a rotor or drive mechanism. The discrete positions are each constituted by a conduit surface extending upwardly into a cavity defined by the housing of the switch and the movable contact is defined by an arm having a contact surface which mates with the conduit surface of the stationary contacts and also includes a pair of cam surfaces extending from the contact surface but which are adapted to engage the conduit surface of the stationary contacts as the contact arm is moved, thereby to wipe against the clean c onduit surfaces of the stationary contact elements. The switch is sealed from the atmosphere by a rubberlike resiliently deformable washer member internally of a portion of the housing which mates against and seals with the rotor and the base of the housing.

This invention relates generally to switches and more particularly to a miniature rotary switch adapted for microcircuitry applications.

Switching devices adapted for use in the microcircuit field have been continuously reduced to smaller and smaller sizes in order to be compatible with the remainder of the circuit elements presently found in such applications. It has been found, however that as the switches grow smaller and smaller the reliability thereof; particularly under stress operation, decreases. Furthermore, the contact areas thereof also decrease. As the contact areas decrease, contact resistance thereof increases and as a result operating disadvantages and problems occur. The increased contact resistance experienced in the prior art switches appreciably raises the minimum amount of current which the switching devices will pass and as a result thereof greatly reduces the usability of the switching device in the microcircuit field for which it was designed originally.

Accordingly it is an object of the present invention to provide a miniature rotary selector switch having multiple positions each with the capability of passing a very low minimum current and which switch is extremely simple in configuration, is rugged in construction, and is extremely reliable in operation.

It is another object of the present invention to provide a miniature selector rotary switch having relatively large contact areas as compared to prior art switches of similar exterior dimensions.

It is another object of the present invention to provide a miniature rotary selector switch having high unit contact pressures to provide reliable contact which can be maintained even under adverse operating conditions.

It is another object of the present invention to provide a miniature rotary selector switch which is extremely small which has a plurality of contact points, and yet which is sealed to preclude the entry of foreign contaminants and moisture.

Additional objects and advantages of the present invention will become apparent from a consideration of the following description taken in conjunction with the accompanying drawing which is presented by way of example

only and is not intended as a limit upon the scope of the claims appended hereto and in which:

FIG. 1 is a perspective view partially cut away of a miniature rotary selector switch in accordance with the present invention;

FIG. 2 is a cross-sectional view taken about the lines 2—2 of FIG. 1;

FIG. 3 is a top view partially in cross-section taken about the lines 3—3 of FIG. 2;

FIG. 4 is a view partly in cross-section taken about the lines 4—4 of FIG. 3 and illustrating the relationship of the movable and stationary contacts of a switch in accordance with the present invention.

A miniature rotary selector switch is accordance with the present invention includes a housing which defines a cavity. Disposed within the cavity is a plurality of stationary contact elements which are contacted by a rotary contact element which is rotatably supported within the cavity. Drive means extend through the housing and engage the rotary contact element in such a manner that upon actuation thereof rotary motion is imparted to the contact element to cause it to sequentially contact the stationary contact elements.

Referring now to the drawing and more particularly to FIG. 1 thereof, a switch in accordance with the present invention as illustrated generally at **10** and includes a housing constructed of a base member **11** having an upstanding sidewall **12** which preferably is constructed integrally with the base member **11** to form a lower generally cup shaped portion of the housing. Although the base **11** and upstanding sidewall **12** can be constructed of any material desired, preferably it is molded of an electrically nonconductive plastic material such as an epoxy resin. To complete the housing, there is provided a cover illustrated generally at **13** which includes a top plate **14** having a depending sidewall **15**. The combination of the top plate **14** and the depending sidewall **15** form a generally inverted cup shape member which slips down over the lower cup shape portion of the housing in such a manner that the two sidewalls overlap. The combination of the cover **13** and the lower portion of the housing defines a cavity **16** to which access is provided through an aperture **17** in the top plate **14** of the cover **13**.

A plurality of electrically conductive pin members **21** through **25** extend outwardly from the base **11** and provide electrical contact to stationary contact elements for example such as those shown at **26, 27** and **28**. A rotary contact element illustrated generally at **31** is formed of a washer like portion **32** having an outwardly extended arm **33** preferably formed integrally therewith and is positioned upon a centerpost **35** extending upwardly and into the cavity **16**.

A rotor or drive mechanism illustrated generally at **36** includes a main body portion **37** having a bore **38** provided centrally thereof which is adapted to receive centerpost **35**. An upper extension **39** of the main body portion **37** of the rotor **36** extends through the aperture **17** in the top plate **14** of the cover **13** thus providing communication with the internal mechanism of the switch from outside the housing thereof. A slot or kerf **41** is provided in the upper member **39** for receiving an adjusting tool for actuating the rotary contact element **31**. An outwardly extending flange **42** is provided as part of the rotor **36** and cooperates with a sealing washer **43** to prevent entry of contaminants or moisture through the aperture **17** in the cover **13**. The sealing washer **43** also cooperates with the top portion of the upstanding sidewall **12** to preclude the entry of foreign contaminants through any space between the cover **13** and the sidewall **12** and base **11** of the housing.

A clearer understanding of the relationship of the various parts of the switch in accordance with the present invention may be obtained by the illustration of FIG. 2 to which reference is hereby made. As is illustrated in FIG. 2 the base **11** has a peripheral recess **51** therein which is adapted to receive the lower edge portion **52** of the depending sidewall **15** of the cover **13** in such a manner that the lower edge **52** is crimped into the recess **51** to thus affix the cover **13** to the base **11**.

As is also more clearly illustrated in FIG. 2, the electrically conductive pin members such as that illustrated at **24** are constructed of an integrally formed member which extends completely through base **11** and preferably which are insert molded into place at the time of the formation of the base **11**. As is indicated, the pin members such as that shown at **24** include a flange **55** which is in engagement with the base **11**. Extending upwardly from the flange **55** is the stationary contact **28** which forms a contoured surface **57**. The contact surface **58** provided on the arm **33** of the rotary contact element **31** is designed to conform to the contoured surface **57** as will be more fully explained hereinafter. The rotary contact element also includes a pair of transversely extending cam surfaces as shown at **59** which cooperate with the contoured surface **57** of the contact element **28** to insure firm reliable electrical continuity having low contact resistance between the contoured surfaces **57** and the contact surface **58**. The function and further description of the cam surfaces **59** will be provided below.

A central aperture **60** is provided in the washer like portion **32** of the rotary contact element **31** so that the rotary contact element **31** may be rotatably disposed on the centerpost **35** within the cavity **16** of the switch in accordance with the present invention.

As the rotary contact element **31** is moved into and away from engagement with contoured surface **57** on a stationary contact such as **28** the cam surfaces **59** cause the arm **33** to move up and down. As the arm **33** approaches the contoured surface **57** the cam surface first causes the arm to move upwardly as shown by the arrow **62** into a recess **61** provided in the lower surface of the main body **37** of the rotor mechanism **36**. As the arm leaves the contoured surface **57**, it drops downwardly as illustrated by the arrow **63** so that the contact surface **58** is below the top most portion of the contour surface **57**. It should however be understood that when the arm **33** moves downwardly as indicated by the arrow **63**, the movement is insufficient to cause any portion of the arm to contact the base **11** of the housing.

The centerpost **35** includes an outwardly flared portion **65** which is supported within a raised boss **66** extending upwardly into the cavity **16**. A flange **67** extends outwardly from an electrically conductive pin **68** in such a manner it cooperates with the outwardly flared portion **65** to prevent axial movement of centerpost **35**. As is illustrated in FIG. 2, various component parts of the pin **68** and the centerpost **35** are constructed integrally of an electrically conductive material. The outwardly flared portion **65** provides a shoulder **69** upon which the washer like portion **32** of the rotary contact element **31** rests and moves as it is rotated. The contact between the shoulder **69** and the lower surface of the rotary contact element **31** provides the electrical contact extending externally of the housing for the rotary element of the switch in accordance with the present invention.

A bead **71** extends upwardly from the flange **42** on the rotor mechaninsm **36**. As is clearly illustrated in FIG. 2 the sealing washer **43** is a resiliently deformable rubber like flat annular washer which is sandwiched between the interior surface of the top plate **14** of the cover **13** and the uppermost surface of the bead **71** and the uppermost surface of the upstanding wall **12**. As the lower edge portion **52** of the cover **13** is crimped into place in the recess **51** the sealing member forceably engages the upper surface of the bead **71** and performs two functions thereby. The first of these functions performed by the bead **71** and the rubber like sealing washer **43** is to provide the seal to prevent the entry of contaminants through the aperture **17** as above referred to. The second of these functions is to apply a downward pressure against the rotor mechanism so as to firmly press the rotary contact **31** into intimate electrical contact with the shoulder **69** on the outwardly flared portion **65** of the centerpost **35** thus insuring good noiseless electrical contact. A tang **72** depends downwardly from the main body portion **37** of the rotor and engages a recess or indentation in the rotary contact element **31** to cause movement thereof when the rotor is moved by an adjusting tool inserted in the kerf **41**.

The construction of the indentation and the cooperation of the tang therewith is more readily seen by reference to FIG. 3. As is therein illustrated, the rotary contact element **31** includes a peripheral recess **75**. Since the rotor is loaded against the top portion of rotary contact **31** and the contact is precluded from moving downwardly as a result of the shoulder **69** the tang **72** firmly engages the recess **75** and drives the rotary contact element **31** as the rotor is moved.

As is more clearly illustrated in FIG. 3, the stationary contact elements such as those illustrated at **26**, **27** and **28** are disposed about the outer periphery of the cavity **16** formed within the housing. Preferably the stationary contact elements are evenly spaced and are spaced in such a manner that the rotary contact element breaks contact with one of the stationary contact elements before making contact with the next. It is however to be expressly understood that the reverse order could be arranged should a particular application be demanded so that the electrical contact between two adjacent stationary contact elements was formed before the electrical contact with the preceding stationary contact element was broken.

As was above referred to and as is particularly illustrated in FIG. 1, the arm **33** of the rotary contact element at its terminal end portion **76** is provided with a pair of transversely disposed ears **77** and **78**. By reference to FIG. 4, the specific construction of these ears may be better determined by taking that figure in conjunction with FIG. 3. As is therein illustrated, the ears are formed by stamping the terminal end portion of the arm **33** into a configuration generally on the order of a W-shaped end portion providing a contact surface area **79** which conforms to the contour surface **57** on the contact **28**. The cam surface **59** as above described, and its opposed portion **59A** are formed by the underside of the ears **77** and **78** respectively and operate in such a manner that as the terminal end portion of the rotary contact element approaches the contour surface **57** the outer edge of the cam surface (for example, at **81**) contacts the contour surface **57** at a point such as (for example, at **82**) and as additional force is applied, wipes upwardly toward the uppermost portion of the contour surface **57** until the lowermost portion of surface **59** is beyond the center line of surface **57**. At this point, spring pressure inherent in the contact arm tends to cause the contact to snap into place as illustrated in FIG. 4. The wiping action which occurs as a result of the cooperation between the cam surface **59** and the contour surface **58** assures that a clean electrical contact surface is presented and the pressure which is accomplished by biasing the contact arm **31** in a downward direction as viewed in FIG. 2 assures sufficient contact pressure to provide very low resistance electrical contact thus insuring a very low minimum current.

There has thus been disclosed a miniature rotary switch element which has dimensions of approximately 250 mils in diameter and 100 mils in thickness in a typical device and which has relatively few moving parts which are constructed and assembled in such a manner that an extremely rugged, reliable low contact resistance switching apparatus is provided. Although this invention has been

presented by way of illustrating and describing a specific embodiment thereof in detail, it is to be expressly understood that such description and illustration is not to be taken by way of limitation of the present invention, but that the invention is to be measured by the scope of the claims appended hereto.

What is claimed is:

1. A miniature rotary switch comprising:
(a) a housing defining a cavity therein,
(1) said housing including an integral base and upstanding sidewall, and
(2) a cover member;
(b) a plurality of discrete stationary contact elements each having a surface with a predetermined contour extending upwardly from said base into said cavity,
(1) said stationary contact elements each including pin members extending through said base and externally of said housing thereby to provide electrical contact to said contact elements;
(c) an electrically conductive post member extending through said base externally of said housing;
(1) said post being disposed centrally of said base;
(d) a rotary contact element rotatably disposed upon said post and in electrical contact therewith;
(1) said rotary contact element having an elongated extension for contacting said stationary contact elements and a recess therein;
(2) said extension having a contact surface conforming to said predetermined contour to mateably receive said contoured surface, and a pair of cam surfaces extending outwardly from said contact surface and adapted to engage and wipe against said contoured surface upon movement of said extension; and
(e) a rotor having a downwardly directed tang rotatably mounted upon said post with said tang in engagement with said recess in said rotary contact element and extending through said cover, whereby upon actuation of said rotor said rotary contact element sequentially contacts said stationary contact elements.

2. A miniature rotary switch as defined in claim 1 in which said rotor further includes a recess formed therein, said recess being aligned with said elongated extension of said rotary contact element.

3. A miniature rotary switch comprising:
(a) a housing defining a cavity therein,
(1) said housing including an integral base and upstanding sidewall formed of electrically nonconductive material, and
(2) a cover member;
(b) a plurality of discrete electrically conductive pin members formed integrally with said base and extending therethrough,
(1) the upper end of each said pin member extending into said cavity and forming a contoured surface,
(2) said pin members being equally spaced about the periphery of said cavity;
(c) an electrically conductive post member extending upwardly from said base into said cavity and extending through said base externally of said housing;
(1) said post being disposed centrally of said base;
(d) a washer like member defining an aperture therein rotatably received upon said post,
(1) said washer like member defining a peripheral recess therein and an arm extending outwardly therefrom and formed as an integral part thereof,
(2) said arm terminating in a contact member having a surface conforming substantially to the contoured surface of said pin members and a pair of transversely extending cam surfaces adapted to engage and wipe against the contoured surface of said pin members,
(3) said arm being biased to provide firm contact between said contact surface and said pin members but to preclude engagement of said base by the terminal portion of said arm when said pin members are not in contact therewith;
(e) a rotor having a downwardly directed tang rotatably mounted upon said post with said tang in engagement with said recess in said washer like member and extending through said cover, whereby upon actuation of said rotor said washer like member sequentially contacts said stationary contact elements; and
(f) a sealing member sandwiched between said cover and said rotor and the top surface of said sidewall,
(1) said cover being crimped to said base to load said cover against said sealing member and said rotor against said washer like member.

4. A miniature rotary switch as defined in claim 1 in which said base defines a peripheral recess thereabout, said cover includes a centrally apertured top plate and a depending sidewall, said depending sidewall being in overlapping engagement with said upstanding sidewall, and said sealing member is a flat annular rubber-like member in engagement with the interior of said top plate of said cover, and the lower edge of said depending sidewall of said cover is crimped into said peripheral recess in said base.

References Cited

UNITED STATES PATENTS

2,986,611	5/1961	Rugeris	200—11.21 X
3,255,319	6/1966	Paine	200—11.11

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