Dec. 27, 1966 J. E. BARLOW 3,294,932

WIPING CONTACT SWITCH

Filed May 17, 1965

FIG. 1

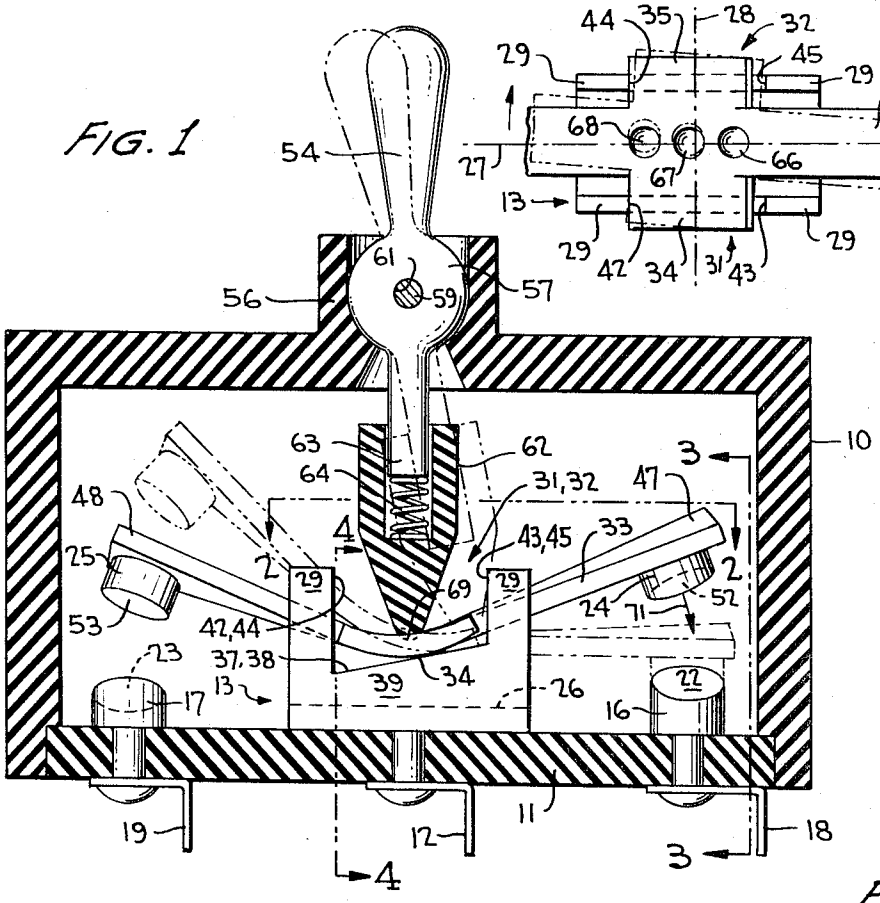


FIG. 2

FIG. 5

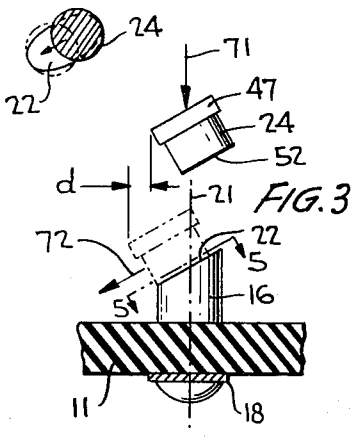


FIG. 3

FIG. 6

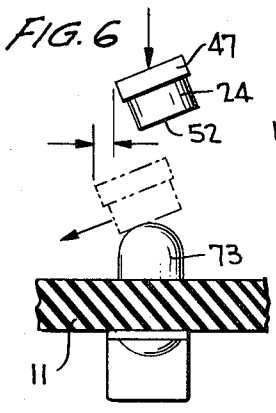
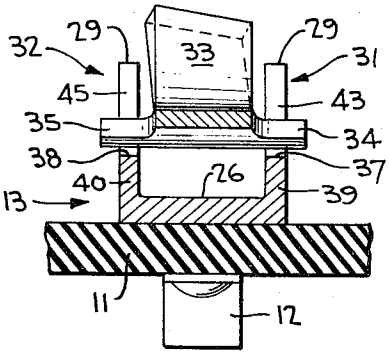


FIG. 4



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WIPING CONTACT SWITCH

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This invention relates to electrical switches and more particularly to switches wherein one electrical contact wipes another electrical contact in completing a circuit.

In electrical switches in which two or more contacts are repeatedly opened and closed, foreign matter commonly collects between the contacts and prevents the closed contacts from establishing an electrical circuit. The foreign matter may result from an arcing between the contacts which forms an oxidized, non-conductive layer on the surfaces of the contacts or from non-conductive substances, such as lint and dust particles, in the atmosphere collecting upon these surfaces. This latter condition is aggravated by the presence of grease, which is frequently used on moving parts of the switches.

Several prior art devices are used to reduce the failures of switches due to the foreign matter between the contacts. One such device provides a resilient spring contact arm to close the contacts. By flexing the spring arm, a wiping or rolling action is produced between the closed contacts. In this device, the metal required for the spring arm is expensive and requires considerable skill in machining or tooling in order to manufacture the arm. Also, the arm must be of considerable length in order to allow the necessary flexing for the wiping or rolling action.

Another prior art device which reduces the failures of contacts is the knife switch. In this switch, a movable knife arm wipes against a resilient or spring contact which is generally parallel to the movement of the knife arm. The spring contact must be made from expensive metal which is difficult to form by stamping and other machining operations. Also considerable force is required for moving the arm as it wipes the parallel spring contact, and thus, is not easily adaptable to small switches without force multiplying lever arrangements for moving the arm.

Accordingly, it is an object of the present invention to provide a miniature electrical switch having improved operating characteristics and which can be constructed from inexpensive metals which are easy to machine.

An additional object of the present invention is to provide a switch having a contact arm movable sequentially in a first arcuate direction to engage a stationary contact and in a second arcuate direction to wipe the contacting surfaces together.

Another object of the present invention is to provide switch wherein a first cylindrical contact having an elliptical contact surface at an acute angle to the axis of the cylindrical contact coacts with a second contact movable into engagement with the first cylindrical contact to produce a wiping action between the two contact surfaces.

A further object of the present invention is to provide a switch having a support for a contact arm which allows an arcuate movement of the contact arm in a first direction for closing a pair of contact surfaces and a predetermined arcuate movement in a second direction for wiping the contact surfaces together.

With these and other objects in view, the present invention contemplates a switching device wherein a contact arm moves sequentially in a first direction for engaging a contact and in a second direction for wiping the contact. More particularly, the device includes facilities for moving arcuately the contact arm in the first direction into engagement with the contact. Upon the engagement, a camming surface on the contact imparts the arcuate movement to the arm in the second direction for wiping the contact. Additionally, a cradle, supporting the arm for the arcuate movement in the first and second directions, has facilities for aligning the arm with respect to the contact.

A complete understanding of this invention may be had by reference to the following detailed description when read in conjunction with the accompanying drawings illustrating embodiments thereof, wherein:

FIG. 1 is an elevational view, partly in section, of an electrical switch of the present invention, showing the general structure thereof;

FIG. 2 is a plan view showing a contact arm held for predetermined arcuate movement by a U-shaped support;

FIG. 3 is an elevational view, partly in section, showing the movement of a contact mounted on the contact arm with respect to a stationary contact;

FIG. 4 is a cross sectional, elevational view of the contact arm showing lateral projections therefrom resting on a camming surface of the U-shaped support;

FIG. 5 is a schematic showing the elliptical surface of the stationary contact and the movement of the movable contact as it wipes across the elliptical surface; and

FIG. 6 is an elevational view partly in section of an alternative embodiment, showing the movement of a contact mounted on the contact arm with respect to a stationary hemispherical contact.

Referring now to FIG. 1, there is shown an electrical switch having a casing **10**, preferably formed of a suitable dielectric material, such as that sold under the trademark "Bakelite." Fixed to the casing **10** by any conventional attaching expedient, such as an adhesive or the like, is a bottom plate **11** composed of a dielectric material similar to that of the casing **10**.

Mounted to the bottom plate **11** of the casing **10** by a terminal **12** is a U-shaped support or cradle **13** made from any suitable electrical conductor, metal, or alloy. On opposite ends of the cradle **13**, a pair of cylindrical stationary contacts **16** and **17** are mounted to the plate **11** by terminals **18** and **19**. The terminal **12** of the cradle **13** is used for electrically attaching an electrical conductor outside of the casing **10** to the cradle **13**. Similarly, terminals **18** and **19** of stationary contacts **16** and **17**, respectively, are used for electrically attaching conductors outside the casing **10** to the contacts **16** and **17**, respectively. Advantageously, the terminals **12**, **18**, and **19** are provided with conventional fastening expedients to attach these conductors thereto, and to secure the corresponding cradle **13** and contacts **16** and **17** to the bottom plate **11**.

The stationary contacts **16** and **17** are generally cylindrically shaped and are formed from any suitable contact metal, or a base metal coated with the suitable contact metal. The upper end of each stationary cylindrical contact **16** and **17** is formed at an acute angle to the longitudinal axis **21**, FIG. 3, of each contact to produce flat, elliptical contact surfaces **22** and **23** on each contact **16** and **17**, respectively. These acute angles are of a degree sufficient to produce wiping motion along the major axes of the elliptical surfaces **22** and **23** upon the closing of movable contacts **24** and **25** while keeping such movable contacts **24** and **25** in engagement with the elliptical surfaces **22** and **23** of the stationary contacts **16** and **17**, respectively.

As to the details of the cradle **13**, the bottom thereof has a rectangular lower surface **26** with a longitudinal axis **27** and a lateral axis **28**, FIG. 2. Four retaining members **29**, each equidistantly spaced from the axes **27** and **28**, extend upwardly from each of the four corners of the rectangular surface **26** to form notches **31** and **32** in the cradle **13**.

Retained by the members 29 is an elongated contact arm 33, which extends parallel to the longitudinal axis 27 between the retaining members 29. The arm 33 is provided with front and rear projections or wings 34 and 35; such projections 34 and 35 extend parallel to the lateral axis 28 through the notches 31 and 32 of the cradle 13 and rest on lower camming surfaces 37 and 38 formed on side walls 39 and 40. The side walls 39 and 40 extend upwardly from the rectangular lower surface 26 into the notches 31 and 32.

Each notch 31 and 32 is of sufficient width to allow free movement of each arm projection 34 and 35 for a predetermined distance from the left side 42 and 44 of each notch 31 and 32 to the right side 43 and 45 of each notch 31 and 32. The lower camming surfaces 37 and 38 of the notches 31 and 32, upon which the arm projections 34 and 35 rest, are formed at an acute angle to the rectangular lower surface 26 of the cradle 13. This angle is sufficient to cam the arm projections 34 and 35 to the left sides 42 and 44 of the notches 31 and 32. Also, the arm projections 34 and 35 and the lower surfaces 37 and 38 of the notches 31 and 32 establish an electrical connection from the terminal 12 to the arm 33.

The arm 33 is formed from any suitable electrical conductive metal or metal alloy. Advantageously, the ends 47 and 48 are bent upwardly to form a curve around a point midway between the ends 47 and 48 of the arm 33, as shown in FIG. 1. It is from opposite sides of this midpoint of the arm 33 that the projections 34 and 35 extend into the supporting notches 31 and 32 formed in the cradle 13. Alternately, the arm 33 may be straight, or the projections 34 and 35 may extend from opposite sides of one end of the arm without departing from the scope of the invention.

The cylindrical contacts 24 and 25 are welded on the respective ends 47 and 48 of the arm 33. The arm contacts 24 and 25 are formed from any suitable contact metal or a base metal coated with the suitable contact metal. The arm 33 is twisted at each end 47 and 48 so that contact surfaces 52 and 53 on the arm contacts 24 and 25 are at an acute angle to the lateral axis 28 along which the arm projections 34 and 35 extend. Preferably, this angle is equal to the acute angle formed by the elliptical contact surfaces 22 and 23 on the stationary contacts 16 and 17 with a plane normal to the cylindrical axis of the stationary contacts 16 and 17. Also, the twist of the ends 47 and 48 of the arm 33 is in a direction such that each contact surface 52 and 53 on the arm contacts 24 and 25 will mate with the elliptical contact surfaces 22 and 23 on the correspondingly associated stationary contacts 16 and 17.

A lever 54 is pivotally mounted in a flange 56 in top of the casing 10. A ball joint 57 on the lever 54 is movably secured in the flange 56 by a pivot pin mounted in the ball joint 57 extending through holes 61 in the flange 56 for restricting pivotal movement of the lever 54 to one direction parallel to the longitudinal axis 27 and arm 33.

A plunger 62 is slidably mounted on the lever end 63 which extends inside of the casing 10. The plunger 62 is formed from any suitable dielectric material to insulate the lever 54 from the arm 33. A spring 64 biases the plunger 62 against the arm 33.

Expediently, three shallow indentations 66, 67, and 68 spaced in the arm 33 receive a tip 69 of the plunger 62 to restrict the lever 54 to three differential positions. Or, the right and left indentations 66 and 68 may be absent and, in such absence, the right and left positions of the lever 54 are determined by the extent of lever movement allowed by the flange 56. Also, the center indentation 67 may be absent and, in such absence, the lever is restricted to only two positions.

When all three indentations 66, 67, and 68 are present and the lever 54 is in a central vertical position, the spring-biased plunger tip 69 is seated in the center indentation 67. The plunger 62 forces the arm projections 34 and 35 against the lower camming surfaces 37 and 38 of the notches 31 and 32 in the cradle 13. Each arm projection 34 and 35 is cammed to the left side 42 and 44 of each notch 31 and 32, respectively, by the coaction of the sloping bottom surfaces 37 and 38 on the projections 34 and 35. Thus, the ends 47 and 48 of the arm are aligned over the stationary contacts 16 and 17, respectively.

When the plunger tip 69 is in either the right or left indentation 66 or 68, the downward force of the spring 64 on the plunger 62 and arm 33 produces an arcuate movement of the arm 33 to engage the right or left arm contact 24 or 25 with the right or left stationary contact 16 or 17, respectively.

Operation

In operation, a plurality of electrical circuits to be selectively controlled are attached to the terminals 12, 18, and 19 of the electrical switch.

Assuming, for example, that the operator desires to connect an electrical circuit attached to the terminal 12 to another circuit attached to the terminal 18, the operator moves the lever 54 to its leftward position, as shown in dashed lines in FIG. 1. Such leftward movement of the lever 54 compresses slightly the spring 64 and moves the tip 69 of the plunger 62 out of the center indentation 67 of the arm 33 and into the right indentation 66 thereof. This movement places the plunger 62 in the position shown in dashed lines in FIG. 1. The tip 69 in the right indentation 66 exerts a downward force on the arm 33, thus producing an arcuate movement on the arm 33 in a first direction, as shown by the arrow 71, FIGS. 1 and 3, and thus engaging the sloping contact surface 52 of the right arm contact 24 with the sloping contact surface 22 of the stationary contact 16.

This engagement of the contact surface 52 with the contact surface 22 results in a camming action between such surfaces 52 and 22 to produce an arcuate movement of the arm 33 in a second direction, as shown by the arrow 72, FIGS. 2 and 3. This movement has a component normal to the first direction 71 of arcuate movement produced by the applied force from the plunger 62.

As the arm 33 moves in the second direction 72, the rear projection 35, FIG. 2, on the arm 33 moves from the left side of the notch 32 to abut the right side 45 of the notch 32 and thus stop the arcuate movement of the arm 33 in the second direction 72.

The movement of the projection 35 within the notch 32 wipes the projection 35 against surface 38 of the notch 32. This wiping removes any foreign matter between the lower surface 38 and the projection 35 to insure that a good electrical connection between the cradle 13 and the arm 33 is maintained.

Also, the arm contact 24 moves a distance *d* normal to the first direction 71 while engaging the stationary contact 16 to wipe the movable contact surface 52 on the elliptical surface 22. The wiping movement is along the major axis of the elliptical surface 22. Such wiping rubs any foreign matter off the surfaces 22 and 52; thus insuring that the contacts 16 and 24 establish a good electrical connection through the center terminal 12, the cradle 13, the contact arm 33, the arm contact 24, the stationary contact 16, and the right terminal 18.

Moving the lever again to the vertical position moves back the spring-biased plunger tip 69 into the center indentation 67 of the arm 33. The downward force of the spring-biased plunger 62 on the center indentation 67 produces reverse arcuate movement of the arm 33 in the first direction 71 to return the arm 33 to its initial position.

Also, the camming action of the lower surfaces 37 and 38 of the notches 31 and 32 in the cradle 13 on the projections 34 and 35 of the arm 33 produces a reverse arcuate movement of the arm 33 normal to the first direc-

tion 71 to realign the arm ends 47 and 48 above the stationary contacts 16 and 17 along the longitudinal axis 27 of the cradle 13.

By moving the upper portion of the lever 54 to the right, the spring-biased plunger 62 moves out of the center indentation 67 into the left indentation 68. Such movement of the plunger 62 moves arcuately the arm 33 to engage contact 25 of the arm 33 with stationary contact 17.

Upon this engagement, a camming action between the left contacts 17 and 25 similar to the camming action between the right contacts 16 and 24 wipes the left arm contact surface 53 against the left stationary contact surface 23. Thus, an electrical circuit is completed through the left terminal 19, the left stationary contact 17, the left arm contact 25, the arm 33, the cradle 13, and the center terminal 12.

Then, moving the lever 54 back to the vertical position returns the contact arm 33 to the initial position.

In the preferred embodiment, an angle of 25° of both (1) the stationary elliptical contact surfaces 22 and 23 with a plane normal to the axes of the contacts 16 and 17 and (2) the bottom surfaces 37 and 38 of the notches 31 and 32 with a plane normal to the sides 42, 43, 44, and 45 of the notches 31 and 32 is sufficient to produce the respective camming actions.

Alternate embodiment

In an alternate embodiment shown in FIG. 6, each truncated cylindrical stationary contact 16 and 17 may be replaced by a hemispherical contact 73. The hemispherical surface of the contact 73 acts as the camming surface to produce arcuate movement of the contact arm 33 in the second direction. Using the hemispherical contact 73 eliminates the need to orient the truncated contacts 16 and 17 in the assembly of the switch. However, the area of contacting surfaces in the alternate embodiment is less than the area of contacting surfaces in the preferred embodiment. The lesser contacting surfaces reduces the current capacity of the contacts. Therefore, the switch of this embodiment finds application in switching expedients using only small electrical currents, such as miniature electronic equipment.

It is to be understood that the above-described embodiments are only illustrative of the principles of the invention and many others could be devised without departing from the scope of the invention.

What is claimed is:

1. A switch comprising:
a contact arm;
a pair of projections on said contact arm, each projection extending from opposite sides of said contact arm;
a cradle having a pair of contact surfaces thereon, each for supporting one of said projections, respectively, said cradle including means for allowing arcuate movement of said contact arm in first and second directions, said first direction of arcuate movement being arcuate about an axis through said projections and transverse to the arm, and said second direction having a component of direction perpendicular to said first direction;
a contact surface on said contact arm at an acute angle to said first direction of arcuate movement and parallel to said second direction of arcuate movement;
a stationary contact;
said stationary contact including camming means for moving said contact arm in said second direction; and
means for moving arcuately said arm in said first direction to engage said arm contact surface with said stationary contact camming means to wipe said arm contact surface on said stationary contact.

2. A switch comprising:
an elongated contact arm movable arcuately in first and second directions and having a pair of lateral projections extending from opposite sides of said contact arm, said first direction being arcuate about an axis through said projections, and said second direction having a component of motion perpendicular to said first direction;
a cradle having a rectilinear upper surface with a member extending upwardly from each corner thereof;
a pair of notches formed by said members on each side of said cradle for receiving each lateral projection, each notch having a width sufficient to allow a predetermined arcuate movement of said contact arm through a predetermined angle in said second direction;
a pair of lower cam surfaces, one in each notch, at an acute angle to said members for supporting each lateral projection;
a contact surface on said contact arm at an acuate angle to said first direction;
a stationary contact having a cam surface for camming said contact arm in said second direction; and
means for selectively providing a force on a first point of said contact arm for forcing said projections against said cam surfaces of said notches to cam said projections to align said contact arm with said stationary contact and on a second point of said contact arm for moving arcuately said contact arm in said first direction to engage said arm contact surface with said stationary contact cam surface to move arcuately said contact arm through said predetermined angle in said second direction to wipe said engaging contact surfaces.

3. A switch comprising:
a stationary contact;
a contact arm having oppositely extending projections;
means for selectively applying a downward force upon a first point of the arm and then upon a second point of the arm;
a U-shaped cradle having each side thereof positioned about opposite sides of the arm and wherein,
(1) each side has a notch into which a respective one of the projections extends, and
(2) the lower surface in each notch supports the respective projection to allow arcuate movement of the arm in a first direction into engagement with the stationary contact when the force applying means applies a downward force on the second point;
means on the stationary contact for producing arcuate movement of the arm in a second direction which has a component of direction normal to the first direction to wipe the arm on the stationary contact when the arm engages the stationary contact; and
each side of the cradle including means for camming the projections to align the arm with respect to the stationary contact when the force applying means applies a force on the first point and the arm moves out of engagement with the stationary contact.

4. A switching device comprising:
a support having a rectilinear upper surface with a longitudinal axis and a lateral axis perpendicular to the longitudinal axis;
an upwardly extending retaining member located at each corner of the rectilinear surface of the support, the members being equidistantly spaced from each axis;
a stationary contact;
an elongated contact arm having a pair of oppositely extending projections which are parallel to the lateral axis and between the members;
a pair of support surfaces on the support upon which the projections rest for pivotally supporting the arm, said support surface including means for camming the projections into engagement with respective members;

first means for arcuately moving the arm about an axis parallel to the projections in a first direction toward the stationary contact to engage the arm with the stationary contact;

second means on the stationary contact for arcuately moving the arm in a second direction which has a component of direction perpendicular to the first direction to wipe the arm on the stationary contact when the arm engages the stationary contact, the projections engaging respective members to allow only predetermined movement of the arm in the second direction; and

whereby the camming means realigns the arm with the stationary contact when the first means removes the arm from engagement with the stationary contact.

References Cited by the Examiner

UNITED STATES PATENTS

1,294,053	2/1919	Cole.	
2,248,362	7/1941	Krieger.	
2,497,306	2/1950	Landmeier	200—164 X
2,938,986	5/1960	Baskerville et al.	200—164
3,024,333	3/1962	Brandenberg	200—164 X

OTHER REFERENCES

Maecker: German Application 1,003,318, publ. 2/1957.

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