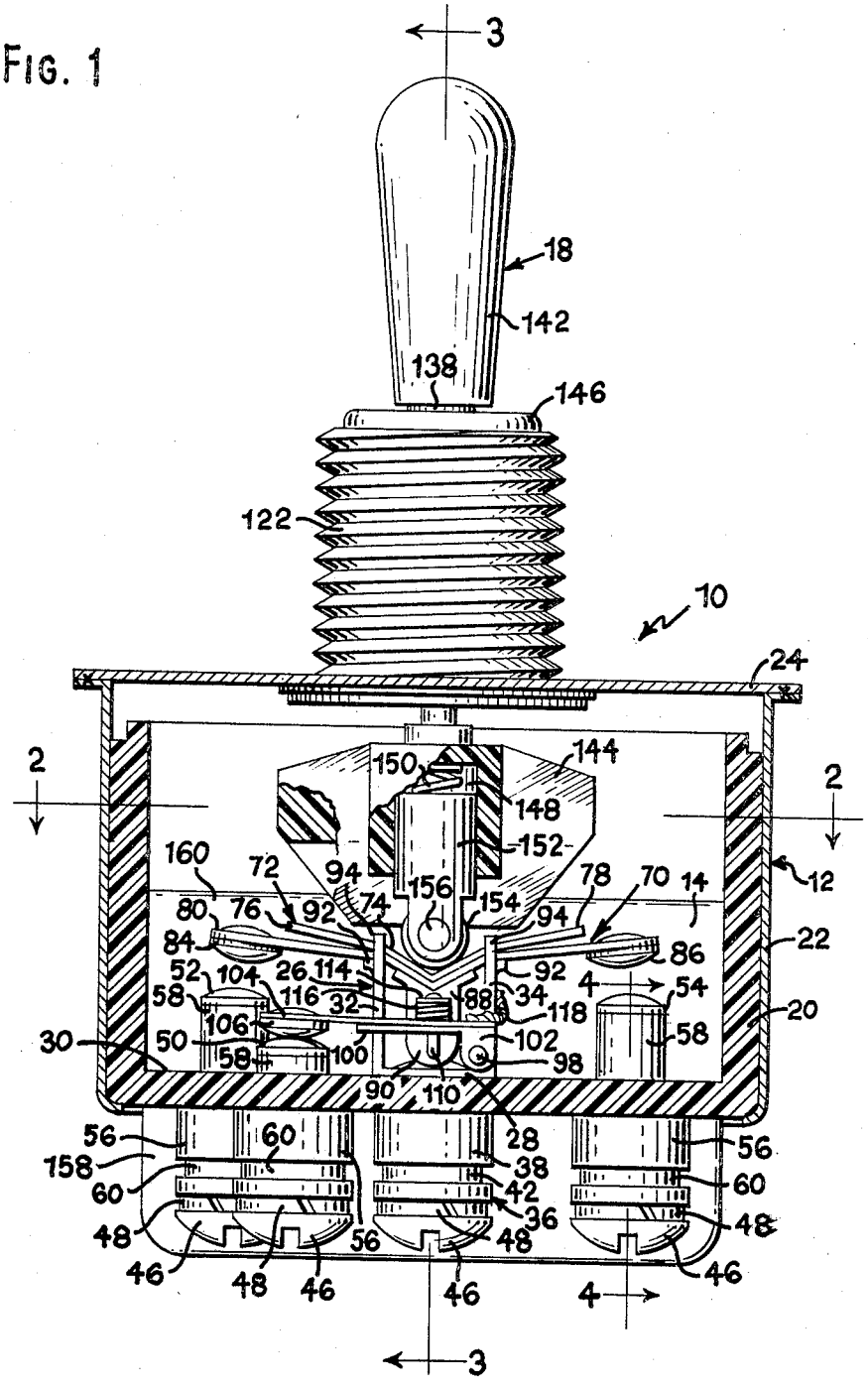
Dec. 2, 1969 C. E. SANFORD 3,482,067

THREE-CIRCUIT SNAP-ACTING TOGGLE SWITCH

Filed May 12, 1967 4 Sheets-Sheet 1

FIG. 1



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THREE-CIRCUIT SNAP-ACTING TOGGLE SWITCH

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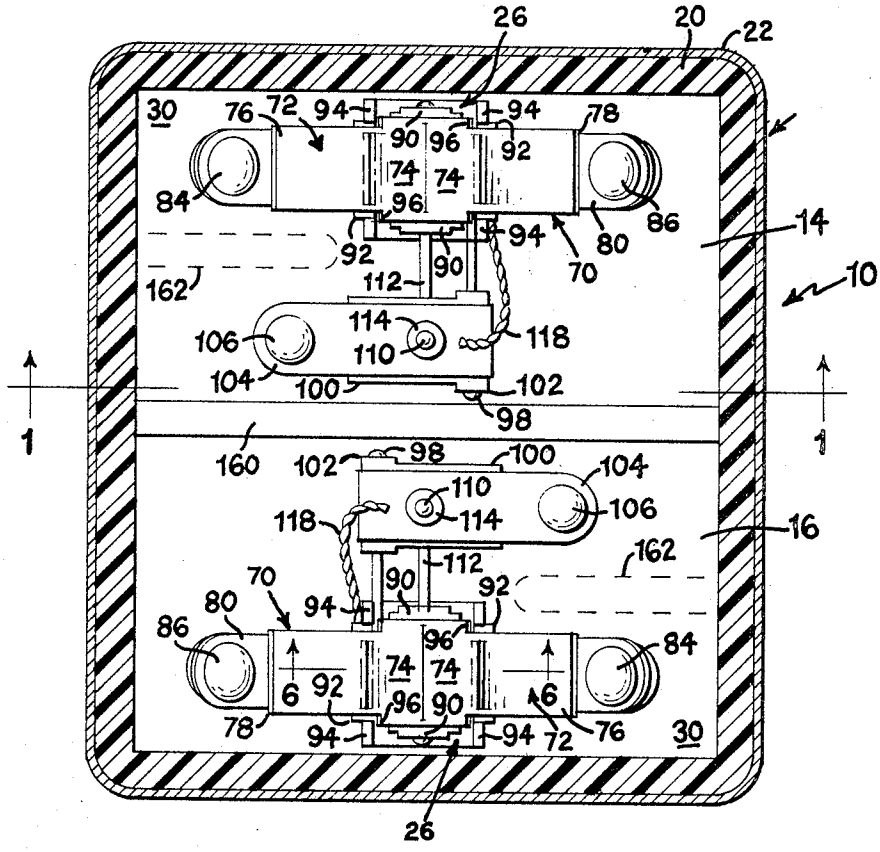


FIG. 2

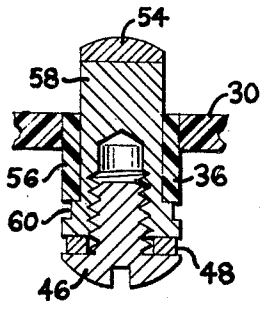


FIG. 4

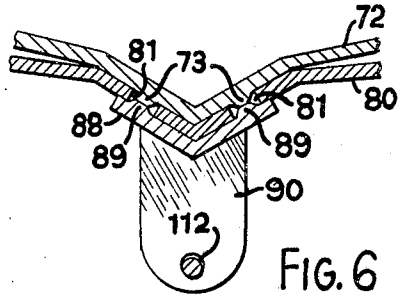


FIG. 6

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THREE-CIRCUIT SNAP-ACTING TOGGLE SWITCH

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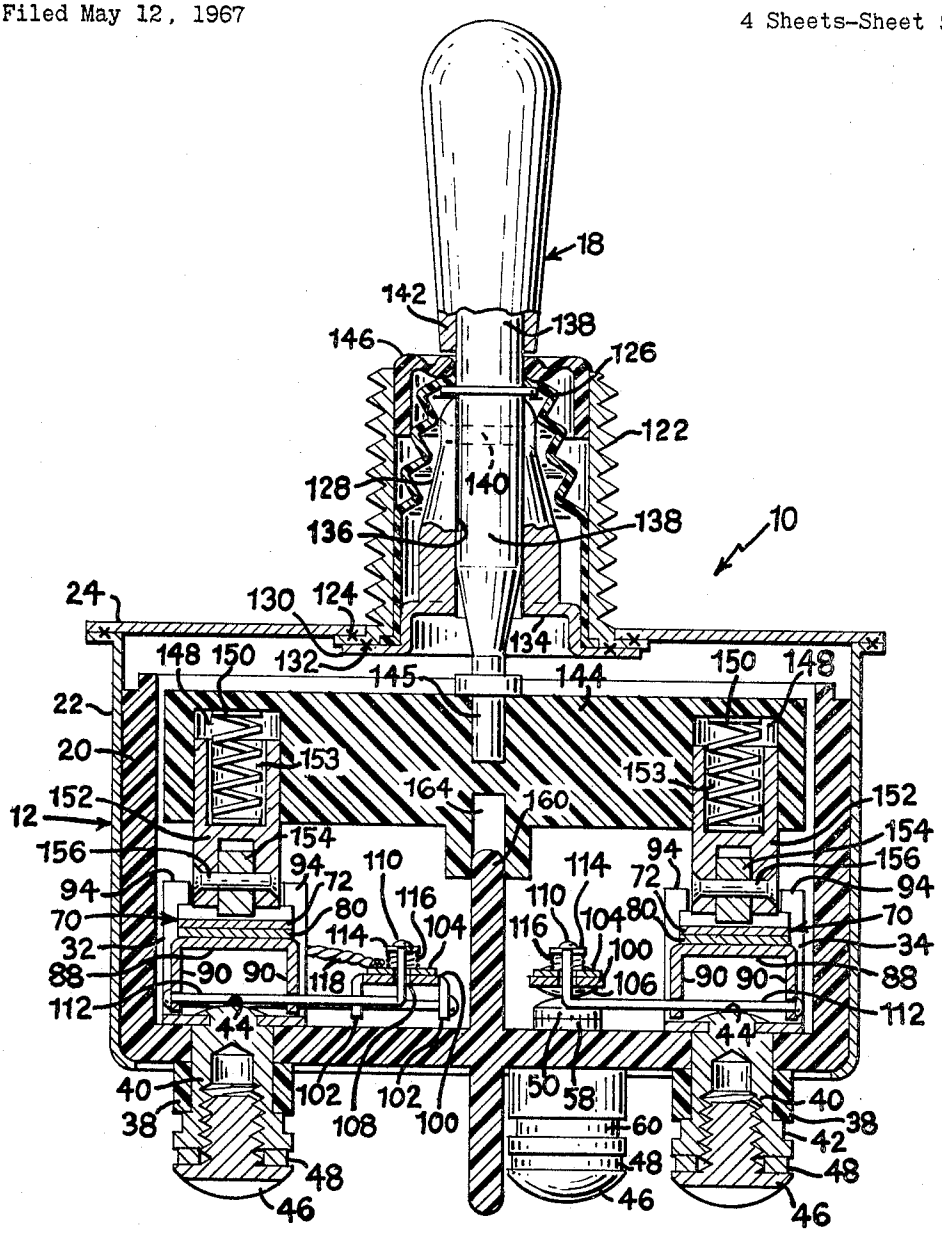


FIG. 3

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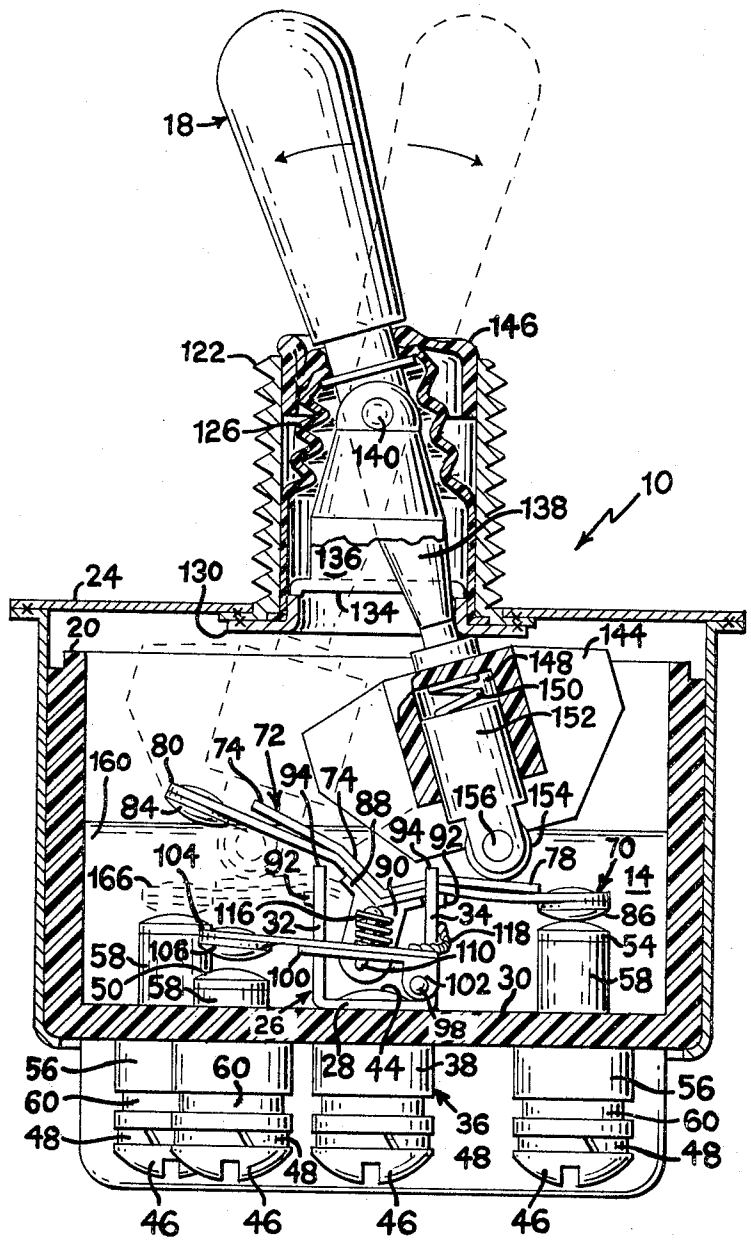


FIG. 5

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3,482,067

THREE-CIRCUIT SNAP-ACTING TOGGLE SWITCH

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Int. Cl. H01h 21/04
U.S. Cl. 200—67 9 Claims

ABSTRACT OF THE DISCLOSURE

A three-position toggle switch, which alternately closes one of three circuits between a common contact and respective additional contacts, is shown to have a common contact in the form of a U-shaped bracket. This bracket has its central portion fixed to a base and has its ends upstanding from the base. Three additional contacts are spaced on the base and a contact arm means is rested across the upstanding ends of the U-shaped bracket to be rocked on the bracket into alternate engagement with the respective additional contacts. A toggle mounted on the base resiliently engages the central portion of the contact arm means between the upstanding ends of the U-shaped bracket to hold the contact arm means in engagement with the bracket contact and with one of the additional contacts for closing one circuit, the toggle being movable to either of two other alternate positions resiliently engaging respective end portions of the contact arm means for rocking the contact arm means on the bracket contact with snap action into alternate engagement with respective additional contacts for closing respective alternate circuits.

In aircraft and aerospace applications and the like, where a large number of controls must be mounted in a limited space, the switches employed should be as compact as possible while fulfilling the greatest possible number of functions. It is also desirable that such switches hold switch contacts firmly together in good electrical contact under conditions of severe vibration; that such switches open and close switch contacts rapidly to minimize contact arcing and wear; and, for many applications, that such switches have toggle actuating means which are easy to operate and which clearly indicate switch condition by observation of the position of the toggle means.

It is an object of this invention to provide a novel and improved toggle switch; to provide a toggle switch for alternately closing circuits between a contact and each of three additional contacts; to provide such a switch in which contacts are held firmly together in closed circuit position; to provide such a switch in which switch contacts are moved to open and closed circuit positions with snap-action for minimizing contact arcing and wear; to provide such a switch in which switch contacts are brought together with a wiping action to assure good electrical connection between the contacts; and to provide such a switch which is of simple, compact, rugged and inexpensive construction.

Briefly described, the toggle switch of this invention comprises a base having a common electrical contact which is in the form of an electrically conductive U-shaped bracket. This bracket contact is mounted with its central or bottom portion fixed to the base and with its end portions or arms upstanding from the base. Three additional contacts are fixedly mounted on the base in spaced relation to each other and to the U-shaped bracket. Terminal means are preferably connected to the respective contacts.

In accordance with this invention, electrically conductive contact arm means are rested across the upstanding

ends of the U-shaped bracket so that the ends of the contact arm means extend outwardly over each of the ends of the U-shaped bracket. The contact arm means preferably has three contacts resiliently mounted thereon, these contacts being adapted to engage the respective additional contacts mounted on the base for completing respective circuits between the U-shaped bracket contact and the additional contacts.

A toggle means is movably mounted on the base for resiliently bearing against the contact arm means to hold the contact arm means in firm engagement with the U-shaped bracket. The toggle means is movable along the contact arm means for rocking the contact arm means on the U-shaped bracket and for moving the contacts on the contact arm means with snap action into alternate engagement with the respective additional contacts on the base for completing respective circuits between the bracket contact and the additional contacts. That is, the toggle means normally engages the contact arm means at a location between the upstanding end portions of the U-shaped bracket, firmly holding the contact arm means in one switch position closing a circuit between the bracket contact and one of the fixed contacts on the base. When the toggle means is moved to resiliently bear against either extending end portion of the contact arm means, the contact arm means is rapidly rocked to a new switch position closing a circuit between the bracket contact and another of the fixed base contacts.

In this simple, compact, rugged and inexpensive construction, resilient engagement of the toggle means with the contact arm means opens and closes the switch contacts with snap action. This same resilient engagement holds switch contacts firmly together in closed circuit position. The resilient mounting of contacts on the contact arm means assures that a wiping action occurs when the contacts are brought into engagement with the fixed base contacts.

Other objects, advantages and details of the switch of this invention appear in the following detailed description of preferred embodiments of the invention, the description referring to the drawings in which:

FIG. 1 is a side elevation view of the toggle switch of this invention, with the switch housing partially cut away, showing the switch closing a circuit;

FIG. 2 is a section view along line **2—2** of FIG. 1;

FIG. 3 is a section view along line **3—3** of FIG. 1;

FIG. 4 is a section view along line **4—4** of FIG. 1;

FIG. 5 is a view similar to FIG. 1 showing the switch of FIG. 1 in an alternate switch position closing another circuit; and

FIG. 6 is a partial section view, to enlarged scale along line **6—6** of FIG. 2.

Referring to the drawings, **10** in FIGS. 1–3 and 5 indicates the novel and improved toggle switch of this invention which is shown to include two separate poles mounted in a common base or housing **12**, the poles preferably being enclosed in separate housing compartments **14** and **16** to be actuated by a common toggle means **18**. The toggle switch could be embodied in a single pole device or in other multipole devices within the scope of this invention. In describing the toggle switch of this invention, corresponding elements of each pole of the illustrated switch are identified by the same numerals.

As illustrated, the switch **10** includes a base or housing **12** which preferably includes a liner **20** of a ceramic material, a phenolic resin or other suitably strong, electrically insulating material and a protective outer casing **22** of steel or other metal. A cover **24** is welded or otherwise secured to the casing in conventional manner.

In accordance with this invention, a U-shaped bracket contact **26** preferably formed of silver plated, cold rolled steel or other suitably rigid material of high electrical

conductivity, has its central or bottom portion **28** secured to the base **30** of the insulating liner and has its ends or distal portions **32** and **34** upstanding from the base as shown. Terminal means **36** accessible from outside the housing are electrically connected to the bracket contact **26**. For example, a bushing **38** of insulating material such as a phenolic resin is disposed in alignment with an aperture in the liner base **30** and an electrically conductive stud **40** is fitted within the bushing, the stud having a flange **42** engaging one end of the bushing **38** and having a staked or riveted end **44** holding the bracket contact **26** to the liner base. A terminal screw **46**, together with a washer **48**, is threadedly engaged with the stud **40** for facilitating attachment of a lead to the stud terminal. See FIGS. 3 and 4.

Three additional electrical contacts **50**, **52** and **54** are fixedly mounted on the liner base **30** in spaced relation to each other and to the U-shaped bracket contact **26**. For example, as illustrated particularly in FIG. 4, insulating bushings **56** are secured in apertures in the liner base and electrically conductive studs **58** are secured within the respective bushings in any conventional manner with stud flanges **60** engaging one end of the bushings. Terminal screws **46** and washers **48** are then attached to the studs. The contacts **50**, **52** and **54** are welded, soldered or otherwise secured to respective studs **58**, the contacts preferably comprising a silver oxide alloy or other material of high conductivity. Although, the liner **20**, the bushings **38** and **56**, and the studs **40** and **58** may be mounted in the switch **10** as shown, it will be understood that the casing **22** could completely enclose the liner **20**, and the terminal studs **40** and **58** could extend through the casing in insulated but hermetically sealed relation to the casing for hermetically sealing the switch **10**.

In accordance with this invention, a contact arm means **70** is rested upon the upstanding ends **32** and **34** of the U-shaped bracket contact **26** so that end portions of the contact arm means extend outwardly over the ends of the U-shaped bracket. In a preferred construction, the contact arm means includes a rigid, main contact arm member **72**, preferably of cold rolled steel or other rigid material, the member preferably having two flat, central portions **74** forming an acute included angle which extends at least slightly downward to form a slight depression between the upstanding bracket arm **32** and **34**. The end portions **76** and **78** of the member **72** extend out over respective ends of the bracket and are preferably turned slightly downward as illustrated in FIGS. 1 and 5. A correspondingly shaped resilient flexible member or strip **80** of electrically conductive material such as beryllium copper is attached to the rigid member **72**, the resilient member supporting a pair of contacts **84** and **86** at respective ends of the resilient member. These contacts are preferably formed of the same material as the contacts **50**, **52** and **54** and are preferably riveted or otherwise fixedly secured to the resilient member. A smaller rigid member **88** is also preferably attached to the opposite side of the resilient member **80**, this rigid member having downwardly depending ears **90**.

For example, the resilient member **80** is provided with apertures **81**, as shown in FIG. 6, and pairs of weld projections **73** and **89** on the respective rigid members **72** and **88** fit within the apertures **81** and are welded together for trapping the resilient member between the rigid members. In this arrangement, the contact arm means **70** rests securely on the upstanding bracket arms **32** and **34** but is adapted to be rocked on the bracket as can be seen. For facilitating this rocking, the bracket **26** preferably has outwardly bent portions **92** engaging the contact arm means and preferably has ears **94** preventing lateral movement of the contact arm means on the bracket. Tabs **96** on the rigid member **72** engage the bracket ears **94** for preventing longitudinal movement of the contact arm means on the bracket.

In accordance with this invention a headed pivot pin **98** is welded or otherwise fixed to the bracket contact **26** to extend laterally from the bracket and a rigid, auxiliary contact arm **100** having downwardly depending ears **102** is rotatably mounted on the pivot pin **98**. A resilient member or strip **104** is further welded or attached to the auxiliary arm **100** and carries a contact **106** at the distal end of the resilient member. The contact arm **100** is preferably of substantial length so that small angular movement of the arm provides substantial movement of the distal end of the arm. As shown particularly in FIG. 3, the auxiliary contact arm **100** and the resilient member **104** are apertured at **108** and an end **110** of a J-shaped pin **112** carried in the depending ears **90** of the rigid member **88** extends upwardly through this aperture to engage the top side of the resilient member **104**. Preferably a washer **114** is carried on the end **110** of the pin and a helical coil compression spring **116** is mounted on the end **110** of the J-shaped pin between the washer **114** and the resilient member **104**. Preferably a pigtail lead or braid or the like **118** is welded or otherwise secured in good electrical contact to the resilient member **106** and to the bracket contact **26** close to the pivot pin **98** for assuring electrical connection of the bracket and resilient member during pivoting of the auxiliary contact arm on the pin **98**. Where the pigtail is close to the pin **98**, pivoting of the auxiliary contact arm causes little or no wearing of the pigtail.

In accordance with this invention, the toggle actuating means **18** is pivotably mounted on the base or housing **12** for resiliently engaging the contact arm means **70**. For example, in a preferred construction, an exteriorly threaded, preferably metallic, bushing **122** useful in mounting the toggle switch **10** on a control panel or the like is welded to the housing cover **24** as at **124** and a metal bellows **126** is fitted within the bushing as shown. A toggle supporting member **128** preferably having a flange **130** welded to the bushing **122** as at **132** has a central bore **134** and a slot **136** for receiving a toggle lever **138**, the toggle lever being pivotably attached to the member **128** by a riveted pin **140**. A knob **142** is cemented or otherwise attached to the toggle lever exteriorly of the switch housing and a toggle block **144**, preferably of ceramic material, phenolic resin or other strong, electrically insulating material is attached to the toggle lever within the switch housing at **145**. A flexible rubber gasket or the like **146** is preferably fitted within the bushing **122** for weather-sealing to protect the bellows **126**. The toggle block **144** has two recesses **148** retaining helical coil compression springs **150**, each recess also retaining a slide **152** having a bore **153** and having a roller **154** rotatably attached to the slide by a pin **156** so that the spring **150** biases the slide to move out of the toggle block recess **148**. In the arrangement, as illustrated, the rollers **154** are positioned to resiliently engage the respective contact arm means **70** in the separate poles of the switch **10** and are adapted to be moved longitudinally along the contact arm means by movement of the toggle lever **138**.

In a preferred construction of the switch **10**, the housing liner **20** preferably has a depending portion **158** electrically separating the terminals of the separate switch poles and has a wall **160** within the housing also separating the separate compartments **14** and **16** of the switch. If desired, additional walls may be formed on the liner **20** as indicated by the broken line **162** in FIG. 2 for separating the individual switch contacts within each pole of the switch. In a desirable switch construction, the toggle block **144** has a groove **164** slidably fitted over the liner wall **160** for guiding the toggle block during motion of the toggle lever.

The operation of the switch **10** is as follows. When the toggle actuating means **18** is in the switch position illustrated in FIG. 1, the roller **154** in one switch pole resiliently engages the central portions **74** of the contact arm means **70** for holding the contact arm means in firm elec-

trical contact with the U-shaped bracket **26**. In this switch position, the contact arm means is disposed in a generally horizontal position resting on the U-shaped bracket and the depending ears **90** of the contact arm means are in their lowest position. The ears **90** therefore hold the J-shaped pin **112** in its lowest position so that the spring **116** is fully compressed depressing the auxiliary contact arm **100** with its resilient member **104** for holding the contact **106** carried by the resilient member in firm electrical contact with the contact **50** mounted on the liner base **30**. When the spring **116** is omitted, the end **110** of the J-shaped pin may directly engage the resilient member **104** for holding the contacts **106** and **50** in engagement. However, the spring **116** is preferably used as shown to assure engagement of the contacts **106** and **50** even if the contacts should be substantially worn away. In this way the switch **10** closes only a single circuit in each switch pole, this circuit extending through the terminal stud **40**, the U-shaped bracket **26**, the pigtail **118**, the resilient member **104** on the auxiliary contact arm **100**, and the contact **106** to the contact **50** and the terminal stud **58** attached to the contact **50**. The toggle slide **152** is held extended from the recess **148** in the toggle block by the spring **150** so that the rollers **154** cannot move on the contact arm means without riding up on the contact arm portions **74** and compressing the spring **150**. Thus the contacts **106** and **50** are held firmly together in good electrical contact. A corresponding circuit is closed in the other pole of the toggle switch as will be understood.

The toggle means **18** is movable to an alternate switch position such as that illustrated in FIG. 5 for opening the circuit above-described and for closing an alternate circuit with the contact **54**. For example, pivoting of the toggle means **18** forces the roller **154** to ride up on the portions **74** of the contact arm means **70** compressing the spring **150** in the toggle block. As the roller passes over the end **34** of the U-shaped bracket contact **26** and is moved out onto the end **78** of the contact arm means extending over that end of the U-shaped bracket, the contact arm means **70** is rocked sharply into the position shown in FIG. 5. That is, as the roller passes over the bracket end **34**, the spring **150** rapidly extends causing the roller **154** to rock the contact arm means sharply while continuing to maintain good electrical contact between the bracket contact **26** and the resilient member **80** of the contact arm means. When this occurs, the contact **86** carried by the contact arm means is engaged with the contact **54** with snap action, flexing of the resilient member **80** providing a wiping action between the contacts **86** and **54** to assure good electrical contact therebetween. The flexibility of the resilient member **80** also serves to damp any tendency for the contact **86** to bounce as it engages the contact **54**. The rigid member **72** in the contact arm means bears down on the resilient member **80** to assure that the contacts are retained in good electrical contact even under conditions of severe vibration. As the contact arm means rocks to this new switch position, the ears **90** and the J-shaped pin **112** are elevated for lifting the auxiliary contact arm **100** together with the resilient member **104** and the contact **106** sharply away from the contact **50** opening the circuit formed with the contact **50** with snap action. Although the auxiliary contact arm has only limited angular movement, this arm is rigid and its distal end is located beneath the resilient member **104** to move the contact **106** sharply away from the contact **50** even if there should be some tendency for the contact **106** to stick to the contact **50**. In this way, movement of the toggle means **18** opens one circuit and substantially simultaneously closes an alternate circuit, this alternate circuit extending through the terminal stud **40**, the U-shaped bracket **26**, the resilient member **80** on the contact **54** arm means and the contact **86** to the contact **54** and the terminal stud **58** attached to the contact **54**.

As will be understood, movement of the toggle means **18** from the position shown in FIG. 5 to the position shown in FIG. 1 opens the circuit between the contacts **86** and **54** with snap action and recloses the circuit between the contacts **106** and **50**. Similarly movement of the toggle means **18** to the right from the position shown in FIG. 1 moves the roller **154** to the left onto the end portion **76** of the rigid member **72** rocking the contact arm means **70** to another position, indicated by the broken lines **166** in FIG. 5, for opening the circuit between the contacts **106** and **50** and for closing another alternate circuit between the contacts **84** and **52**. This latter alternate circuit extends through the terminal stud **40**, the bracket contact **26**, the resilient member **80** of the contact arm means **70** and the contact **84** to the contact **52** and the terminal stud **58** attached to the contact **52**.

Thus the three-position switch **10** of this invention is adapted to close alternate circuits between the common bracket contact **26** and each of the additional contacts **50**, **52** and **54**. The switch holds contacts firmly together in closed circuit position; the switch brings contacts together for closing each circuit with wiping action to assure good electrical connection between the switch contacts; and the switch contacts are brought together or moved apart to close or open switch circuits with snap action to minimize contact wear. In addition, the single spring **150** in each switch pole serves to hold pairs of the switch contacts together with substantially equal pressure in closing each of the three switch circuits. Further, the switch **10** is of compact, simple, and inexpensive construction while being adapted for long use under conditions of severe vibration.

It should be understood that although particular embodiments of the invention have been described by way of illustration, this invention includes all modifications and equivalents of the illustrated embodiments falling within the scope of the appended claims.

What is claimed is:

1. A toggle switch for alternately closing one of three circuits comprising an electrical insulating base, a common electrically conductive U-shaped bracket contact having its central portion secured to said base and its two ends upstanding from said base, three additional electrically conductive contacts mounted on said base in spaced relation to each other and to said common contact, an auxiliary electrically-conductive contact arm means electrically connected to said common contact, and means mounting said contact arm for pivotal movement relative to one of said additional contacts, a main electrically conductive contact arm means mounted for pivotal movement on said common contact, and means connecting to said auxiliary contact arm and main contact arm for holding said auxiliary contact arm in engagement with said one additional contact to close one circuit between said common contact and said one additional contact, toggle means mounted on said base engaging said main contact arm means for holding said one circuit closed, said toggle means being movable for rocking said main contact arm means on said common contact into engagement with respective additional contacts to close alternate circuits between said common contact and said respective additional contacts and for pivoting said auxiliary contact arm out of engagement with said one additional contact to open said one circuit.

2. A toggle switch as set forth in claim **4** wherein said means mounting said auxiliary contact arm comprises a pivot pin secured to said common bracket contact extending laterally thereupon, said auxiliary contact arm means being mounted for pivotal movement on said pin.

3. A toggle switch as set forth in claim **2** wherein said auxiliary contact arm means includes a rigid arm member pivotably mounted at one end in said pin, a resilient strip secured at one end to said rigid arm, and an electrically conductive contact mounted on the distal end of said resilient strip for wiping engagement with said one additional contact.

4. A toggle switch as set forth in claim 1 wherein said main contact arm means includes a rigid arm member, a resilient strip secured at its central portion to the central portion of said rigid arm, and a pair of electrically conductive contacts mounted on respective distal ends of said resilient strip for wiping engagement with respective additional contacts.

5. A toggle switch as set forth in claim 4 wherein said means connecting said auxiliary arm comprises means mounting a J pin beneath said rigid arm extending laterally therefrom, and spring means mounted on said pin engaging said auxiliary contact arm means for connecting said main contact arm means and said auxiliary contact arm means.

6. A toggle switch for alternately closing one of three circuits comprising an electrically insulating base, a common electrically-conductive U-shaped bracket contact having its central portion secured to said base and its ends upstanding from said base, three additional electrically conductive contacts mounted in said base in spaced relation to each other and to said common contact, a pivot pin secured to said common bracket contact extending laterally therefrom, a rigid auxiliary contact arm pivotably mounted on said pin, a first electrically conductive resilient strip secured at one end to said auxiliary contact arm and electrically connected to said bracket contact, a contact mounted on the distal end of said resilient strip, a rigid main contact arm, a second electrically-conductive resilient strip secured at its central portion to the central portion of said main contact arm, a pair of contacts mounted on respective distal ends of said strip, said main contact arm being rested on said upstanding ends of said common bracket with said second resilient strip electrically connected to said bracket, said main contact arm having a central depressed portion extending downward between said bracket ends, means connecting said auxiliary contact arm to the central portion of said main contact arm for movement therewith, and toggle means resiliently engaging said central portion of said main contact arm for holding said auxiliary arm contact in engagement with one of said additional contacts to close one circuit between said bracket contact and said one additional contact, said toggle means being movable to two alternate positions engaging respective opposite ends of said main contact arm for rocking said main contact arm on said bracket contact to engage said main arm contacts with said additional contacts to close respective alternate circuits between said bracket contact and additional contacts and to pivot said auxiliary contact arm to open said one circuit.

7. A toggle switch as set forth in claim 6 wherein said auxiliary contact arm and first resilient strip have aligned apertures therethrough, said means connecting said auxiliary contact arm to said main contact arm comprise ear members depending from said main contact arm, a J-shaped pin supported on said ears and having one end extending through said aligned apertures, and spring means mounted in said one end of said J-shaped pin for resiliently holding said auxiliary contact arm in engagement with said one additional contact.

8. A multi-pole toggle switch for alternately closing one of three circuits in each pole between a common contact and three additional contacts in each pole comprising an electrically insulating base, a common electrically conductive U-shaped bracket contact in each pole having its central portion secured to said base and having its two ends upstanding from said base, three additional electrically conductive contacts in each pole mounted on said base in spaced relation to each other and to said common contact, an electrically conductive contact arm means rested across said two ends of each common contact and engaged with one additional contact for closing a first circuit in each pole, and a single toggle means resiliently engaging all of said contact arm means for holding said contact arm means in position to close said first circuits, said toggle means being movable to rock said contact arm means on said common contacts into engagement with either of two additional contacts in each pole to close respective alternate circuits in each pole and to simultaneously open said first circuits.

9. A multi-pole toggle switch for alternately closing one of three circuits in each pole between a common contact and three additional contacts in each pole comprising an electrically insulating base, a common electrically-conductive U-shaped bracket contact in each pole having its central portion secured to said base and having its two ends upstanding from said base, three additional electrically conductive contacts in each pole mounted on said base in spaced relation to each other and to said common contact, a pivot pin secured to each common bracket contact extending laterally therefrom, an auxiliary contact arm means pivotally mounted on each pin for movement relative to one additional contact, a main electrically conductive contact arm means rested across said two ends of each common contact and connected to one of said auxiliary contact arm means, and a single toggle means resiliently engaging a central portion of each of said main contact arm means to hold each auxiliary contact arm means in engagement with said one additional contact for closing a first circuit in each pole, said toggle means being movable to engage either of two end portions of each of said main contact arm means for rocking said main contact arm means on said common contacts into engagement with respective additional contacts to close either of two alternate circuits in each pole and for pivoting said auxiliary contact arm means out of engagement with said one additional contact to open said first circuits.

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