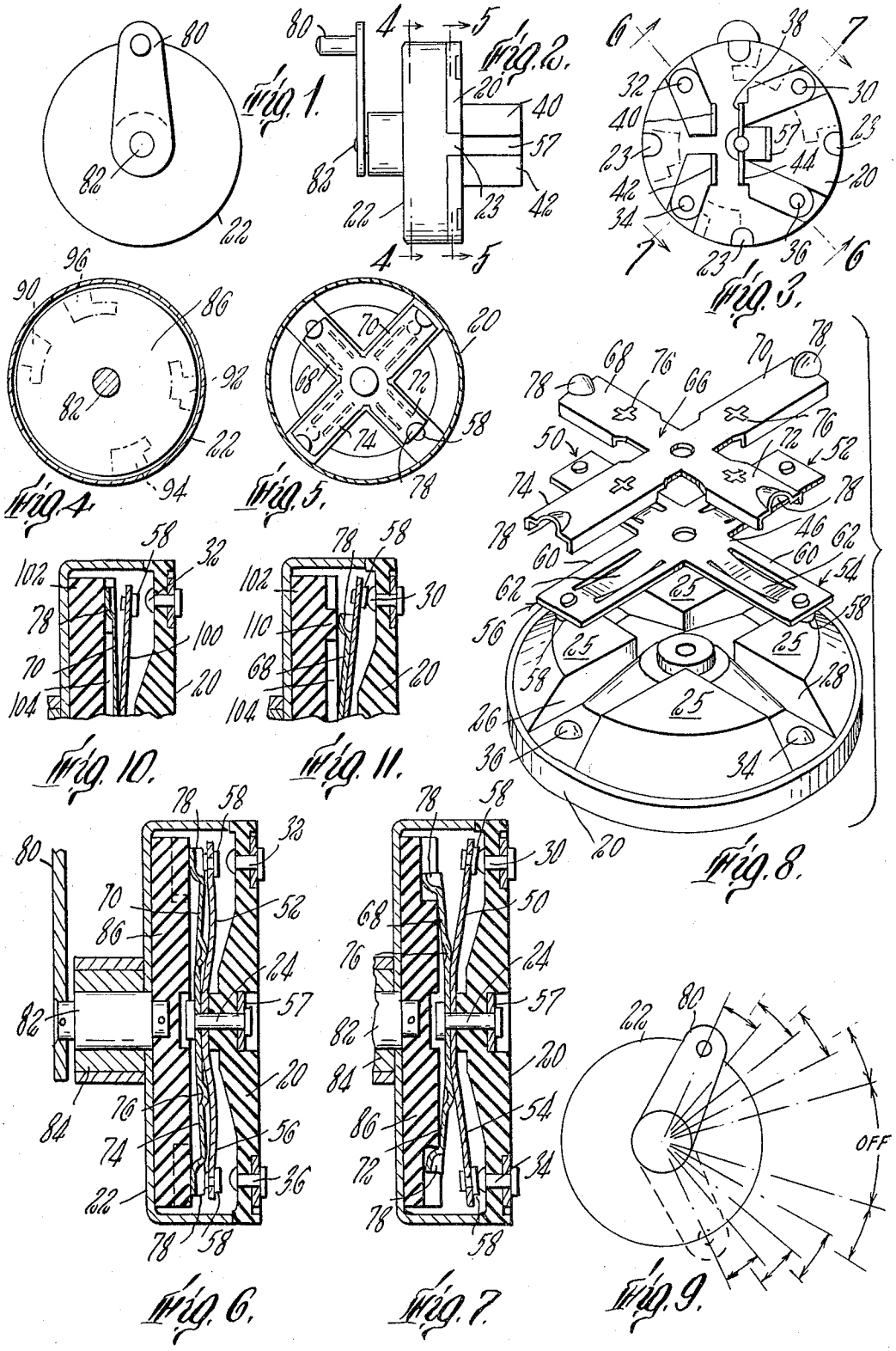
Oct. 25, 1966 W. McKINLEY TENNANT 3,281,552

CAM OPERATED ROTARY SWITCH USING LEAF SPRING AND OVERLYING ACTUATOR

Filed Oct. 12, 1965 2 Sheets-Sheet 1



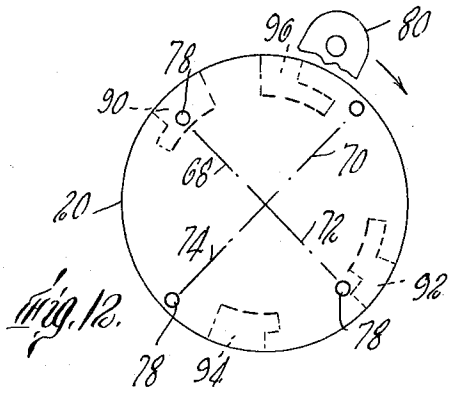


Fig. 12.

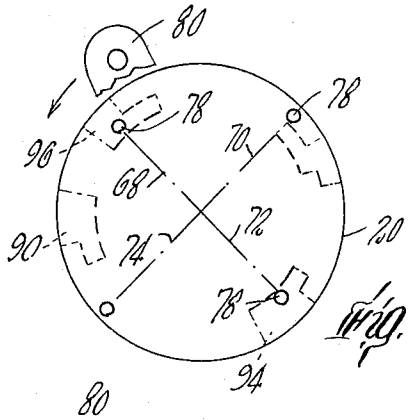


Fig. 16.

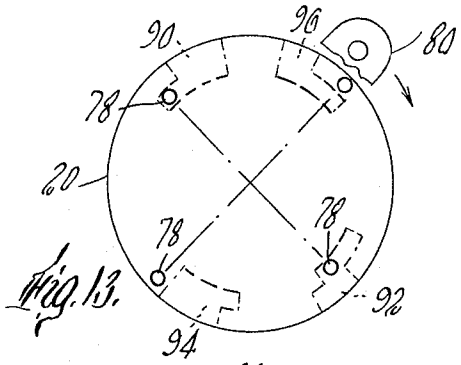


Fig. 13.

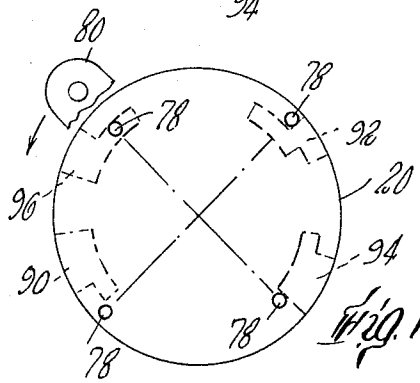


Fig. 17.

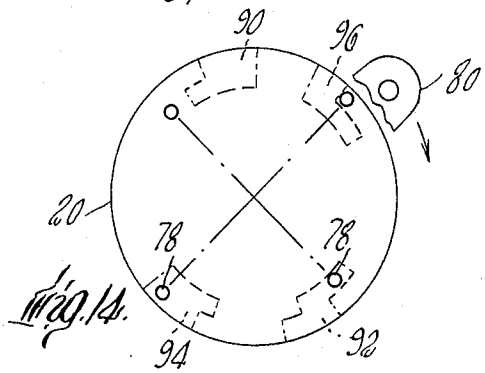


Fig. 14.

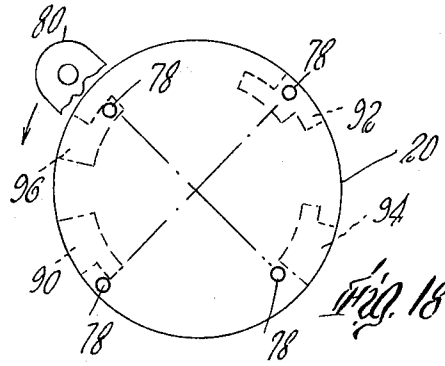


Fig. 18.

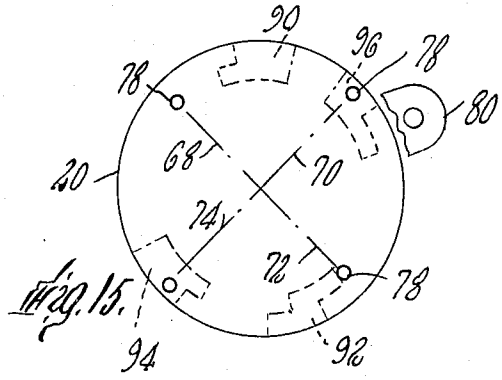


Fig. 15.

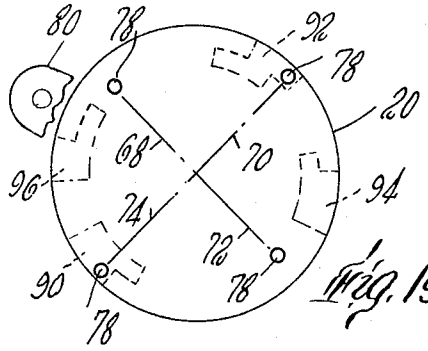


Fig. 19.

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CAM OPERATED ROTARY SWITCH USING LEAF SPRING AND OVERLYING ACTUATOR

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7 Claims. (Cl. 200—63)

The present invention relates to an improved multiple terminal rotary switch of the general type in which the control element is movable to a number of different positions for closing any one or more of a substantial number of different circuits or combinations of such circuits.

It is a principal object of the invention to provide an improved multiple terminal rotary switch which is simple and rugged in construction and readily adjustable to a substantial number of operating positions for connecting a number of different circuits or combinations of such circuits.

It is a further object of the invention to provide an improved multiple terminal rotary switch of this general description, in which the circular base and rotary disc cam cover are so contoured and arranged to provide for the substantial and accurate operation of the rotary switch assemblies mounted therein.

It is a further object of the invention to provide a rugged and efficient multiple terminal rotary switch of this general description employing snap switches which will have a fast and reliable snap action.

The several features of the invention will be readily appreciated from the following description taken in connection with the accompanying drawing in which:

FIG. 1 is a plan view of the rotary switch including the several features of the invention;

FIG. 2 is a view in side elevation of the rotary switch shown in FIG. 1;

FIG. 3 is a bottom plan view of the rotary switch and corresponds to the illustration of FIG. 2 looking from the right;

FIG. 4 is a sectional view taken on a line 4—4 of FIG. 2 illustrating particularly the switch operating cam surfaces of the rotatably adjustable cam disc which forms the operating element of the switch;

FIG. 5 is a sectional view taken on a line 5—5 of FIGURE 2 illustrating particularly the arrangement of the actuating spring arms and snap switch arms;

FIG. 6 is a sectional view taken on a line 6—6 of the bottom plan FIG. 3 showing two opposed snap switch units with the actuating spring arms held down and with the associated snap switch arms in a raised open position;

FIG. 7 is a sectional view through the switch similar to FIG. 6, but taken on a line 7—7 of FIG. 3 but with the switch assembly set in the operating position of FIG. 13, showing the two opposed switch units controlled by the relatively shorter actuating spring arms positioned with the actuating arms raised and with the associated snap switch arms closed;

FIG. 8 is an exploded perspective view showing the several switch components but with the cover of the switch removed;

FIG. 9 is a diagrammatic view illustrating different positions of the switch, indicating four successive step positions of the switch from neutral in each direction; and

FIGS. 10 and 11 illustrate a modification of the invention in which a simple switch arm, normally biased away from its terminal is substituted for the snap switch of FIGS. 1 to 9 to be actuated by a switch actuator arm which is pressed by a raised cam surface on the overlying cam disc of the switch assembly;

FIG. 10 being a sectional view corresponding to FIG. 6; and

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FIG. 11 being a sectional view corresponding to FIG. 7;

FIGS. 12 to 19 inclusive are diagrammatic views illustrating different positions of the switch of which FIGS. 12 to 15 illustrate positions in which the control handle and cam disc have been moved through four successive steps from neutral in a clockwise direction, and FIGS. 16 to 19 inclusive illustrate positions in which the control handle and cam disc have been moved through four successive steps from neutral in a counter-clockwise direction.

The rotary snap switch shown in the drawing as embodying in a preferred form, the several features of the invention comprises a housing including a circular base member **20** to which is fitted a cover member **22** having tabs **23** which are bent over the edges of the base **20** in locking relation thereto as shown in FIGS. 2 and 3. The base member **20**, formed on an insulating material such as plastic, is apertured to receive a central fastening element or rivet **24** which may act as a common contact for the switch. As best shown in FIG. 8, the upper face **25** of the base member **20** is formed with two slots **26**, **28** intersecting at right angles along lines passing through the axis of the base member **20**. Switch contact terminals consisting of round headed rivets **30**, **32**, **34** and **36** are mounted in the base member **20** adjacent the ends of the intersecting slots **26**, **28** and are connected respectively with switch terminal members **38**, **40**, **42** and **44** attached to the under side of the base member **20**. A metallic element **46** having generally the shape of a cross is fitted into the intersecting slots **26**, **28** being centrally supported on an annular supporting surface **48** formed on the base member **22** at the intersection of said slots and held firmly engaged therewith by the rivet **24**. The four arms of the cross shaped metallic element **46**, which may be made of beryllium copper, are formed to provide four leaf spring snap switches **50**, **52**, **54** and **56**, all having contact with the central ground provided by the rivet **24** and a ground terminal member **57** secured thereto, and at their outer ends having contact buttons **58** to be brought into contact respectively with the terminals provided by the round headed rivets **30**, **32**, **34** and **36**. Each leaf spring snap switch is identically formed with two parallel longitudinal cuts forming two outer tension elements **60** and a central compression element **62** which is normally convex upwardly and biases the outer end of the leaf spring snap switch **49** downwardly into engagement with the associated switch contact terminal. It will be understood that each of the snap switches described may be constructed of two separate parts cooperating to produce the desired snap action without departing from the spirit and scope of the invention. Overlying the element **46** in the intersecting slots **26**, **28** is a second flat, metallic, cross-shaped member **66** which is held firmly by the rivet **24**. Each of the arms **68**, **70**, **72** and **74** provided by the member **66** overlie and acts as an actuator for the corresponding spring snap switch provided by the cross-shaped member **46**. Each of the actuator arms **68**, **70**, **72** and **74** is biased upwardly at the outer end and has formed on the under face thereof a nub **76** which engages against the upwardly bowed central compression element **62** of the associated leaf spring snap switch. A downward movement of a said actuator arm acting through the nub **76** and compression element **62** will cause the snap switch to snap upwardly into open position in which the leaf spring snap switch is engaged against the downwardly pressed actuator arm, as shown in FIG. 6. When released, the switch actuator arm will move upwardly releasing the pressure of the nub **76** on the compression element **62** of the leaf

spring snap switch which snaps downwardly to the contact position illustrated in FIG. 7. Each of said actuator arms **68**, **70**, **72** and **74** is provided at its outer end with an upward projection **78** which acts as a cam follower surface. As shown in FIGS. 5 and 8 the actuator arms **70** and **72** are longer than the actuator arms **68** and **74**.

For actuating the switch a rotary controller **80** is secured to a stem **82** which is rotatably mounted on a bearing element **84** on the cover member **22**, and at its inner end is attached to a disc cam **86** which overlies and is rotatable with relation to the actuator arms **68** to **74** inclusive. As best shown in FIGS. 6 and 7, the disc cam **86** is disposed with the inner face thereof engaged against the adjacent top face **25** of the base member **20**, and closely adjacent the actuator arms, so that the upward projections **78** of the associated actuator arms engaging against non-recessed portions of said face will cause said arms to be held in a precisely gaged depressed position in which the associated snap switches are held open. For the off position of the switch shown in FIGS. 1, 2, 4, 5 and 6, all four of the actuator arms **68** to **74** inclusive are held down, so that all four snap switches are disengaged as best shown in FIGS. 4 and 6.

Referring particularly to FIG. 4 and the diagrammatic views **12** to **19** inclusive, the under face of the disc cam **86** is formed with recesses which are arranged for specified angular positions of the controller **80** and disc cam **86** to receive the projections **78** formed on the respective switch arms which are thus permitted to move away from the associated snap switches allowing said switches to close. It will be noted that these recesses are arcuately formed on radii of two different lengths, those arcuate recesses of shorter radius being adapted to receive projections **78** associated with the two shorter actuator arms **68**, **72** while those recesses disposed at a greater radial distance from the rotational axis of the disc cam are arranged to receive the projections **78** associated with the long actuator arms **70**, **74**.

In the embodiment of the invention shown in FIGS. 1 to 9 inclusive, the inner and outer recesses referred to overlap circumferentially and thus merge with one another. For convenience of illustration the two sets of inner and outer recesses are separated from one another in FIG. 4 by a dot-and-dash construction line.

From a consideration of the diagrammatic showing of FIG. 9 taken in connection with FIGS. 12 to 19 inclusive it will be evident that a substantial number of combinations of open and shut snap switches is possible for different angular positions of the controller **80** and disc cam **86** depending upon the arrangement of recesses formed in said cam.

For the position of FIG. 12 in which the controller **80** and cam disc **86** have been turned clockwise, it will be noted that the short switch actuator arm **68** only is released by engagement of its cam follower projection **78** in the recess **90**, causing a circuit to be closed through switch contact terminal **30**.

For the position of FIG. 13 in which the controller **80** and cam **86** have been moved still further clockwise, both short switch actuator arms **68** and **72** are released by the engagement of their cam follower projections **78** in the recesses **90** and **92** respectively causing circuits to be closed through switch terminals **30** and **34**.

For the still further advanced position of FIG. 14 the short actuator arm **72** and the long actuator arm **74** are released by engagement of their cam follower projections **78** in the respective recesses **92** and **94** so that circuits are completed through switch terminals **34** and **36**.

For the extreme clockwise position of FIG. 15 both long actuator arms **70** and **74** are released by engagement of their cam follower projections **78** in the respective recesses **96** and **94**, closing circuits through the switch terminals **32** and **36**.

For the position of FIG. 16 in which the controller and cam disc have been moved counter-clockwise from the neutral position a circuit is closed through switch terminals **30** and **34**. For the further counter-clockwise position of FIG. 17 a circuit is closed only through switch terminal **30**. In FIG. 18 circuits are closed through switch terminals **30** and **32**, and in FIG. 19 switch circuits are closed through switch terminals **32** and **36**.

FIGS. 10 and 11 illustrate a modified construction of my multiple terminal rotary switch in which a switch plate is provided having simple switch arms designated at **100** to take the place of the snap switch arms **50**, **52**, **54** and **56** of FIGS. 1 to 9 inclusive. Each of the switch arms **100** is biased to a raised out-of-contact position along with the overlying actuator arm. In this construction, since the actuator arms must be pressed to engage the switch contact, the abutting face of the disc cam **102** which overlies the switch assembly and corresponds to the disc cam **86** of FIGS. 1 to 9, is radially slotted at **104** to receive the respective actuator arms **68**, **70**, **72** and **74**, and is formed with a peripheral recess **106** in which are received the upwardly biased cam follower surfaces **78** of the respective actuator arms for the out-of-contact position of the respective switches. The actuator arms and associated switch arms **100** are selectively moved to close circuits through any of said terminals **30**, **32**, **34** or **36** by means of raised cam surfaces which correspond exactly in position and in contour to the recess **90**, **92**, **94** and **96** respectively, of the embodiment illustrated in FIGS. 1 to 9 and 12 to 19 inclusive, and operate in the positions of the rotary multiple pole switch shown in FIGS. 11 to 19 to close and open the same circuits. In FIG. 10, for example, which corresponds to FIG. 6 the actuator arm **70** rides in the recess **106** permitting the switch arm to stand in open position. In FIG. 11 which corresponds to FIG. 7, the actuator arm **68** rides on the raised cam surface **110** causing the associated switch arm **100** to be engaged with the contact terminal **30**.

It will be understood that applicant is not limited to the particular arrangement of the switch operators and associated cam operating disc shown, and that changes may be made within the scope of the invention in accordance with the requirements of the electrical circuits to be controlled thereby, and that applicant is not limited to the particular arrangement shown.

The invention having been described what is claimed is:

1. A multiple terminal rotary switch having, in combination, a base support comprising a circular disc of electrically non-conducting material having a common terminal centrally located on the rotational axis of said switch, and a plurality of individual switch terminals spaced radially outwardly from said centrally located common terminal, switch contact arms supported on said disc extending outwardly from said common terminal overlying each of said individual switch terminals, each shiftable between contact and out-of-contact positions and each said contact arm having a bias to one of said positions, a switch actuator arm overlying each of said switch contact arms arranged when pressed to engage and to press the underlying switch arm to the alternate position against said bias, and a disc cam overlying said switch actuator arms rotatably adjustable about said central switch terminal as an axis and providing on the under face thereof cam surfaces for selectively pressing and releasing said switch actuators to close and open said respective switch arms.

2. A rotary multiple terminal switch according to claim **1** in which the adjacent face surfaces of said base and disc cam are engaged to provide precisely gaged positions of said cam surface engaged switch actuator arms, and are relatively grooved radially to receive said switch actuator and switch contact arms.

3. A rotary multiple terminal switch according to claim 2, in which said switch actuator arms are formed with cam follower surfaces disposed at different radial distances from said centrally located common terminal, and cam surfaces are disposed on the under side of said disc cam at radial distances from the rotational axis of said disc cam selected to engage only those cam follower surfaces disposed at the same radial distance from said axis.

4. A rotary multiple terminal switch having, in combination, a circular disc of electrically non-conducting material, having a face thereof formed with a plurality of radial slots, a common terminal centrally disposed in said disc, individual switch terminals disposed outwardly in said several slots, an electrical conductor plate attached to said common terminal having switch contact arms lying in said slots, each shiftable between contact and out-of-contact positions with a said individual switch terminal and biased to one of said positions, an actuator plate overlying said conductor plate having switch actuator arms overlying said switch contact arms in said slots, movable to shift the associated switch arm to the alternate position against said bias, and a disc cam overlying said switch actuator arms rotatably adjustable about said central switch terminal as an axis and providing on the under face thereof cam surfaces for selectively pressing

and releasing said switch actuators to close and open said respective switches.

5. A rotary multiple terminal switch according to claim 4 in which each said switch contact arm is biased to an out-of-contact position with respect to the respective individual switch terminal, and the overlying actuator arm is cam pressed to press the underlying switch contact arm to the contact position.

6. A rotary multiple terminal switch according to claim 4 in which each said individual switch arm is a self-returning snap switch having a bias to the closed contact engaging position, and the upwardly biased overlying actuator arm acts when pressed to shift the underlying snap switch to the out-of-contact position.

7. A rotary multiple terminal switch according to claim 6 in which each snap switch arm is formed with tension and compression areas balanced to bias said snap switch against the associated contact terminal, and each snap switch actuator arm has a bias away from said underlying snap switch arm and a contact surface rendered operative by a downward press movement of the switch actuator arm to engage and snap said snap switch arm open.

No references cited.

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