July 14, 1964 R. F. HILL ETAL 3,141,076

ROTARY SNAP SWITCH

Filed Oct. 15, 1959 3 Sheets-Sheet 1

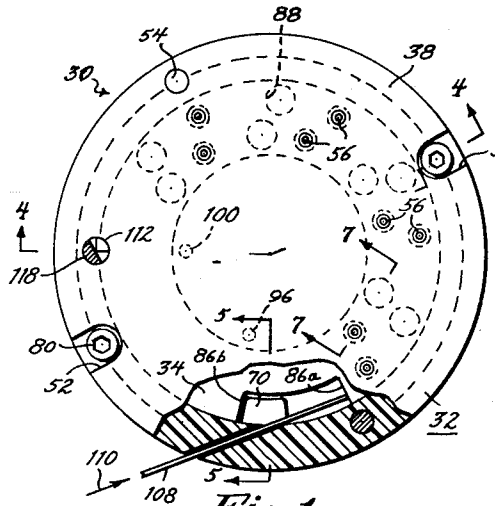


Fig. 1.

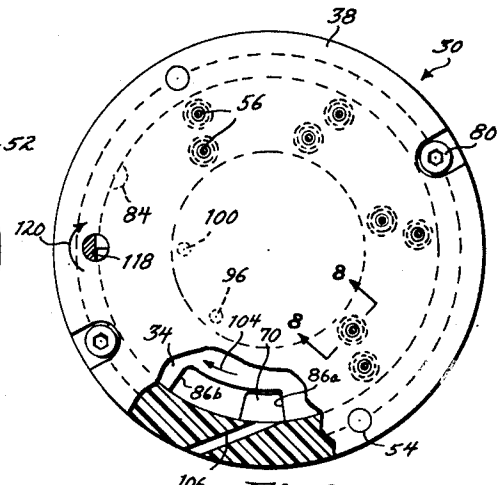


Fig. 2.

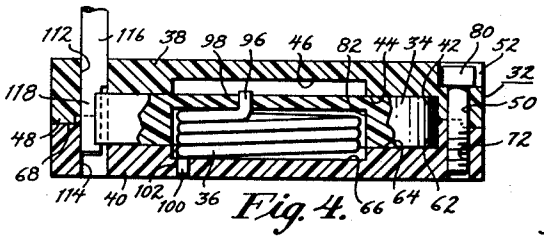


Fig. 4.

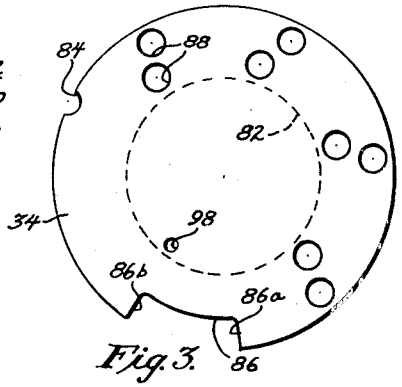


Fig. 3.

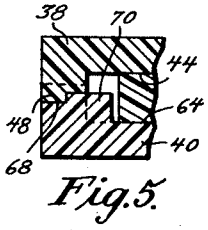


Fig. 5.

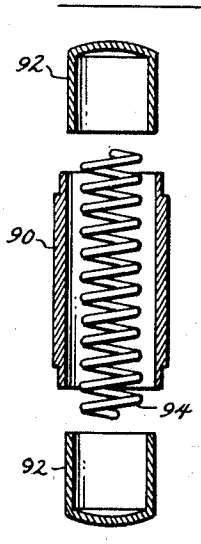


Fig. 6.

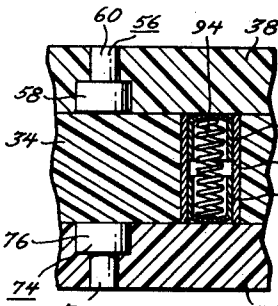


Fig. 7.

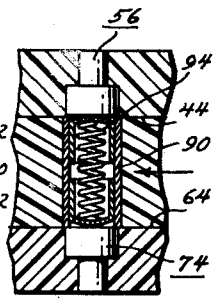


Fig. 8.

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ROTARY SNAP SWITCH

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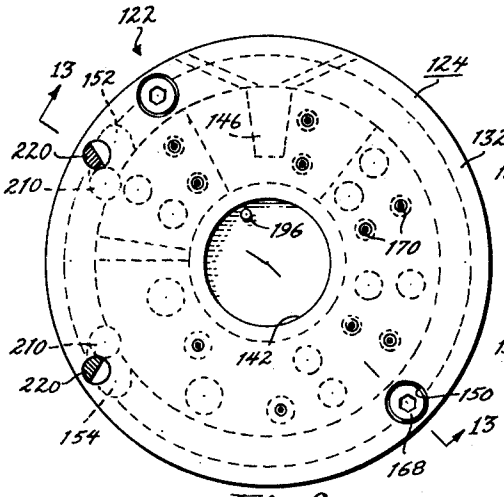


Fig. 9.

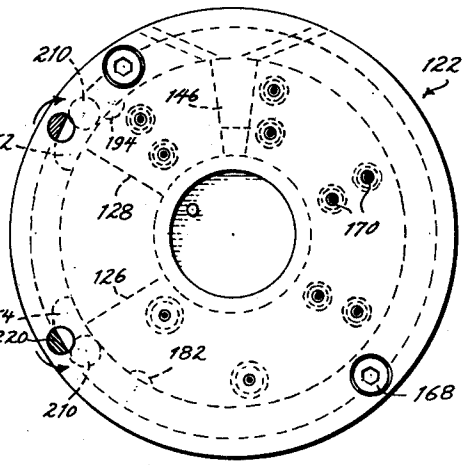


Fig. 10.

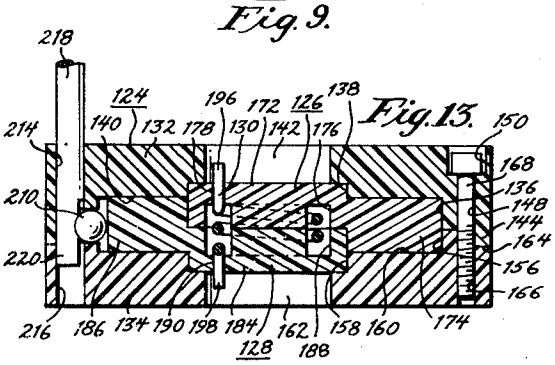


Fig. 13.

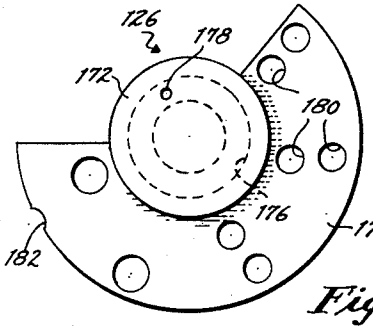


Fig. 11.

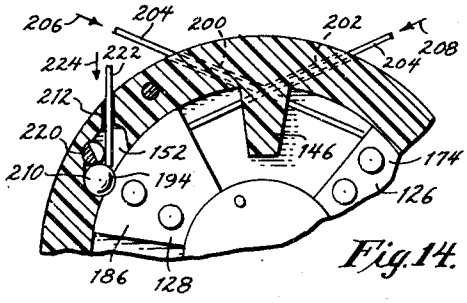


Fig. 14.

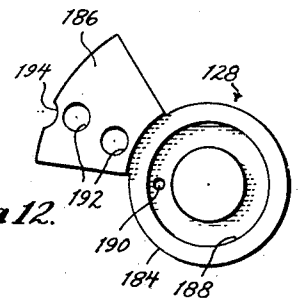


Fig. 12.

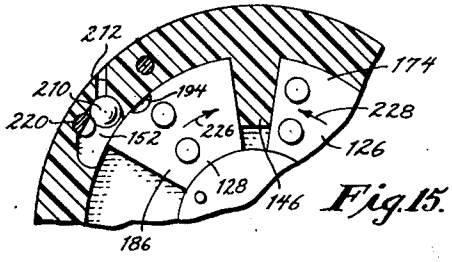


Fig. 15.

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ROTARY SNAP SWITCH

Filed Oct. 15, 1959 3 Sheets-Sheet 3

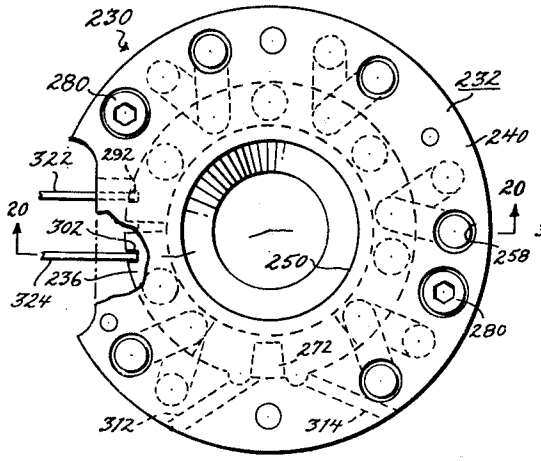


Fig. 16.

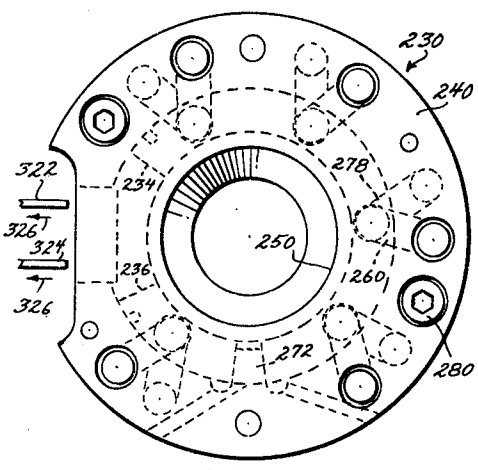


Fig. 17.

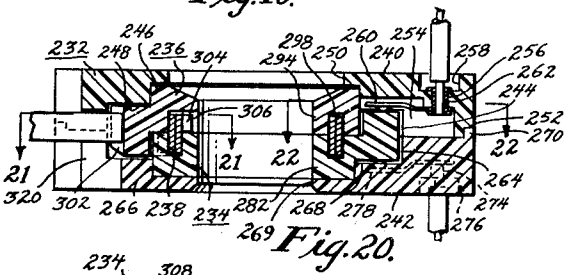


Fig. 20.

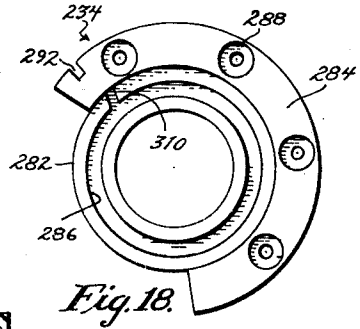


Fig. 18.

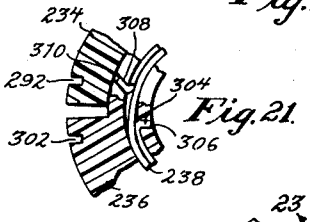


Fig. 21.

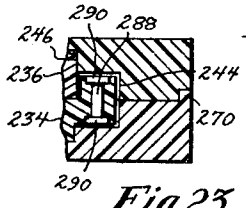


Fig. 23.

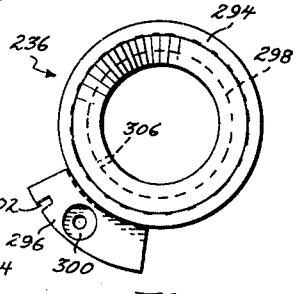


Fig. 19.

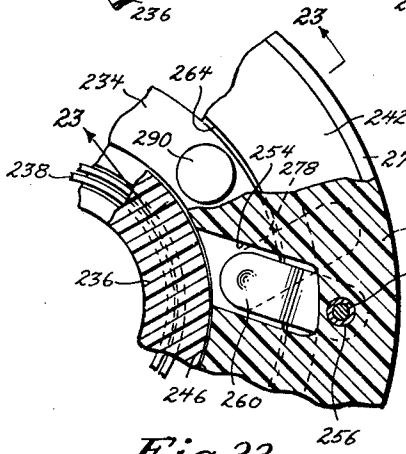


Fig. 22.

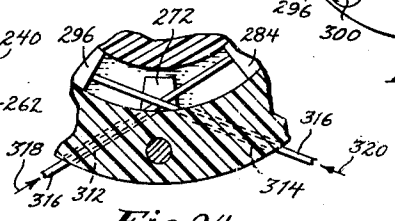


Fig. 24.

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United States Patent Office 3,141,076 Patented July 14, 1964

3,141,076

ROTARY SNAP SWITCH

Randolph F. Hill, Drexel Hill, and Jerome G. Burns, Upper Providence, Pa., assignors to International Resistance Company, Philadelphia, Pa.

Filed Oct. 15, 1959, Ser. No. 846,729
16 Claims. (Cl. 200—74)

The present invention relates to a switch, and more particularly to an electric switch which is adapted to quickly snap to its closed position to close one or more electric circuits.

In many electrical devices, it is desirable to have a switch which can be set to its open position and which can be released to quickly snap to its closed position. Also, there are such electrical devices which require that a single switch close a plurality of circuits either simultaneously, or with one circuit closing just before or just after the other circuits. Such a switch should not only operate in the desired manner but should be small in size, and relatively simple and inexpensive to manufacture.

It is an object of the present invention to provide a novel electrical switch.

It is another object of the present invention to provide a novel snap switch.

It is still another object of the present invention to provide a switch which can be set to its open position and which can be released to quickly snap to its closed position.

It is a further object of the present invention to provide a switch which will simultaneously close a plurality of circuits.

It is a still further object of the present invention to provide a switch for closing a plurality of circuits which will close at least one of the circuits just before or just after closing the other circuits.

It is still another object of the present invention to provide a snap switch which is small and compact, and is relatively simple in construction and inexpensive to manufacture.

Other objects will appear hereinafter.

For the purpose of illustrating the invention there is shown in the drawings forms which are presently preferred; it being understood, however, that this invention is not limited to the precise arrangements and instrumentalities shown.

FIGURE 1 is a top plan view, partly broken away, of a switch of the present invention in its open position.

FIGURE 2 is a top plan view, partly broken away, of the switch of the present invention in its closed position.

FIGURE 3 is a top plan view of the rotor of the switch of the present invention.

FIGURE 4 is a sectional view taken along line 4—4 of FIGURE 1.

FIGURE 5 is a sectional view taken along line 5—5 of FIGURE 1.

FIGURE 6 is an enlarged exploded view, partly in section, of one of the rotor contacts of the switch of the present invention.

FIGURE 7 is a sectional view taken along line 7—7 of FIGURE 1.

FIGURE 8 is a sectional view taken along line 8—8 of FIGURE 2.

FIGURE 9 is a top plan view of a modification of the switch of the present invention in its open position.

FIGURE 10 is a top plan view of the switch shown in FIGURE 9 in its closed position.

FIGURE 11 is a top plan view of one of the rotors of the switch shown in FIGURE 9.

FIGURE 12 is a top plan view of the other rotor of the switch shown in FIGURE 9.

FIGURE 13 is a sectional view taken along line 13—13 of FIGURE 9.

FIGURE 14 is a sectional view of a portion of the switch shown in FIGURE 9 illustrating the manner of setting the switch in its open position.

FIGURE 15 is a sectional view similar to FIGURE 14 showing the switch in its closed position.

FIGURE 16 is a top plan view of still another modification of the switch of the present invention in its open position.

FIGURE 17 is a top plan view of the switch shown in FIGURE 16 in its closed position.

FIGURE 18 is a top plan view of one rotor of the switch shown in FIGURE 16.

FIGURE 19 is a top plan view of the other rotor of the switch shown in FIGURE 16.

FIGURE 20 is a sectional view taken along line 20—20 of FIGURE 16.

FIGURE 21 is a sectional view taken along line 21—21 of FIGURE 20.

FIGURE 22 is a sectional view taken along line 22—22 of FIGURE 20.

FIGURE 23 is a sectional view taken along line 23—23 of FIGURE 22.

FIGURE 24 is a sectional view of a portion of the switch shown in FIGURE 16 illustrating the manner of setting the switch to its open position.

Referring initially to FIGURES 1–8, the switch of the present invention is generally designated as **30**. Switch **30** comprises a casing **32**, a rotor **34** rotatably mounted within the casing **32**, and a spring **36** for actuating the rotor **34**.

Casing **32** comprises a circular top cover **38** and a mating circular bottom cover **40**. Top cover **38** and bottom cover **40** are made of an electrical insulating material, such as a plastic.

Top cover **38** comprises a circular disc having a circular recess **42** in its bottom surface. Recess **42** has a flat base **44**, and a circular recess **46** in the center of the base **44**. A narrow annular flange **48** extends downwardly from the outer edge of the bottom surface of the top cover **38**. The top cover **38** is provided with a pair of holes **50** therethrough, which holes **50** are adjacent the outer edge of the top cover **38** and are diametrically opposite to each other. Each of the holes **50** has a counterbore **52** at the top surface of the top cover **38**. The top cover **38** is also provided with a pair of threaded holes **54** therethrough, which threaded holes **54** are adjacent the outer edge of the top cover **38** and are intermediate the holes **50**.

A plurality of contacts **56** of an electrically conductive metal extend through the top cover **38**. Each of the contacts **56** includes a head **58** the bottom surface of which is flush with the base surface **44** of recess **42**, and a stem **60** the top surface of which is flush with the top surface of the top cover **38** (see FIGURE 7). As shown, the top cover **38** has eight contacts **56** which are arranged around the circumference of two concentric circles which lie in the area between the outer diameter of the recess **46** and the outer diameter of the recess **42**. However, the top cover **38** may include a fewer or greater number of the contacts **56** according to the number of circuits to be controlled by the switch **30**.

Bottom cover **40** comprises a circular disc having a circular recess **62** in its top surface. The recess **62** is of the same diameter and depth as the recess **42** in the top cover **38**. Recess **62** has a flat base **64**, and a circular recess **66** is provided in the center of the base **64**. Recess **66** is of the same diameter as the recess **46** in the top cover **38**. Bottom cover **40** has an annular groove **68** extending around the outer edge of its top surface. An-

nular groove 68 is of a width and depth equal to the width and depth of the annular flange 48 on the top cover 38.

Bottom cover 40 has an integral boss 70 extending upwardly from the base 64 of the recess 62 adjacent the outer wall of the recess 62. A pair of threaded holes 72 extend through the bottom cover 40. Holes 72 are adjacent the outer edge of the bottom cover 40, and are diametrically opposite to each other. Bottom cover 40 also has a pair of counterbored holes, not shown, similar to the holes 50 in the top cover 38. The counterbored holes in the bottom cover 40 are positioned adjacent the outer edge of the bottom cover 40 and are between the threaded holes 72.

A plurality of contacts 74 of an electrically conductive metal extend through the bottom cover 40. Each of the contacts 74 has a head 76 the upper surface of which is flush with the base 64 of the recess 62, and a stem 78 the bottom surface of which is flush with the bottom surface of the bottom cover 40. Bottom cover 40 is provided with the same number of contacts 74 as there are the contacts 56 in the top cover 38. Also, the contacts 74 are positioned around the bottom cover 40 in the same manner that the contacts 56 are positioned around the top cover 38.

Top cover 38 seats on the bottom cover 40 with the annular flange 48 fitting in the annular groove 68 in the bottom cover 40, and with the recess 42 being in alignment with the recess 62. The top cover 38 is positioned on the bottom cover 40 so that the holes 50 in the top cover 38 are in alignment with the threaded holes 72 in the bottom cover 40, and the threaded holes 54 are in alignment with the counterbored holes in the bottom cover 40. Cap screws 80 extend through the holes 50 and are threaded into the holes 72 to secure the top cover 38 to the bottom cover 40. The heads of the cap screws 80 fit into the counterbores 52. Likewise cap screws extend through the counterbored holes in the bottom cover 40 and are threaded into the holes 54 in the top cover 38. As shown in FIGURE 7, the contacts 56 in the top cover 38 are in direct alignment with the contacts 76 in the bottom cover 40.

Rotor 34 comprises a flat circular disc of a diameter equal to the diameter of the recesses 42 and 62 in the top cover 38 and bottom cover 40, and of a thickness equal to the combined depth of the recesses 42 and 62. Rotor 34 has a circular recess 82 in the center of its bottom surface. Recess 82 is of a diameter equal to the diameter of the recess 66 in the base 64 of the recess 62 in the bottom cover 40. Rotor 34 is provided with a semi-cylindrical notch 84 in its outer peripheral edge, and a circumferentially elongated notch 86 in its outer peripheral edge. The elongated notch 86 is circumferentially spaced from the semi-cylindrical notch 84. A plurality of holes 88, equal in number to the number of contacts 56 in the top cover 38, extend through the rotor 34. The holes 88 are positioned between the outer wall of the recess 82 and the outer edge of the rotor 34, and are arranged around the rotor 34 in the same manner that the contacts 56 are arranged around the top cover 38.

A separate metal sleeve 90 is disposed within each of the holes 88, and fits tightly within the hole 88. A pair of cup-shaped, metal contacts 92 are disposed within each of the sleeves 90 with the open ends of the contacts 92 facing each other. The contacts 92 are of a diameter to have sliding engagement with the inner wall of the sleeve 90. A helical spring 94 of an electrically conductive metal is disposed within each of the sleeves 90, and is compressed between the bottoms of the contacts 92.

Rotor 34 is disposed between the top cover 38 and the bottom cover 40 of the casing 32, and rotatably fits within the recesses 42 and 62 in the top cover 38 and bottom cover 40. Rotor 34 is positioned with the recess 82

facing the recess 66 in the base 64 of the recess 62 in bottom cover 40, and with the boss 70 being within the elongated notch 86 in the rotor 34. The springs 94 being compressed, urge the bottoms of the contacts 92 against the bases 44 and 64 of the recesses 42 and 62.

The helically coiled spring 36 is disposed within the recesses 82 and 66 of the rotor 34 and bottom cover 40 respectively. Spring 36 is of a diameter substantially equal to the diameter of the recesses 82 and 66. One end 96 of the spring 36 is bent longitudinally of the spring 36, and extends through a hole 98 in the rotor 34, which hole 98 is adjacent the wall of the recess 82. The other end 100 of the spring 36 is bent longitudinally of the spring 36 and extends through a hole 102 in the bottom cover 40, which hole 102 is positioned adjacent the wall of the recess 66. When the ends 96 and 100 of the spring 36 are inserted in the holes 98 and 102 respectively, the spring ends 96 and 100 are moved circumferentially away from each other from the normally relaxed position to place the spring 36 under a torsional tension. The torsional tension in the spring 36 normally tends to rotate the rotor 34 in the direction of the arrow 104 in FIGURE 2. Thus, the spring 36 normally holds the side 86*a* of the elongated notch 86 in rotor 34 against the boss 70 which acts as a stop to limit the rotation of the rotor 34.

When the side 86*a* of the recess 86 engages the stop boss 70, the holes 88 in the rotor 34 are positioned directly between the contacts 56 of the top cover 38 and the contacts 74 of the bottom cover 40. Thus, each pair of the rotor contacts 92 engages and electrically connects a top cover contact 56 and a bottom cover contact 74, as shown in FIGURE 8. Thus, the switch 30 is in its closed position to electrically connect a plurality of circuits which are connected to the contacts 56 and 74.

To place the switch 30 in its open position, the rotor 34 is rotated in the direction opposite to the arrow 104. To accomplish this, the top cover 38 is provided with a hole 106 extending through the top cover 38 from the outer peripheral surface thereof at an angle to the diameter of the top cover 38. The hole 106 extends toward the side 86*a* of the elongated recess 86 in the rotor 34, and terminates at the wall of the top cover recess 42 adjacent the surface of the boss 70 which engages the side 86*a*. To rotate the rotor 34 to the open position of the switch 30, a rod 108 is inserted through the hole 106 until the end of the rod 108 engages the side 86*a* of the notch 86. By pushing the rod 108 forward in the direction of arrow 110 in FIGURE 1, the rotor 34 is rotated until the side 86*b* engages the stop boss 70 as shown in FIGURE 1. The rotation of the rotor 34 moves the holes 88 in the rotor 34 away from the contacts 56 and 74 of the top cover 38 and bottom cover 40 as shown in FIGURE 7, so that the rotor contacts 92 do not engage the contacts 56 and 74. Thus, the switch 30 is in its open position.

To maintain the switch 30 in its open position, a pair of aligned holes 112 and 114 are provided in the top cover 38 and the bottom cover 40 respectively. The holes 112 and 114 are positioned so that one-half of the holes 112 and 114 extend across the recesses 42 and 62 in the top cover 38 and bottom cover 40. Thus, a portion of the peripheral edge of the rotor 34 extends across one-half of the holes 112 and 114. The semi-cylindrical notch 84 in the rotor 34 is positioned so that when the side 86*b* of the elongated notch 86 engages the stop boss 70, the notch 84 is in alignment with the holes 112 and 114. An actuating rod 116 extends through and is rotatable in the holes 112 and 114. The end of the rod 116 is cut away longitudinally to provide a semi-cylindrical end portion 118 which extends across the edge of the rotor 34. When the rod 116 is rotated so that a portion or all of the end portion 118 of the rod 116 is within the semi-cylindrical notch 84 of the rotor 34, the rotor 34 is secured in its open position against rotation as shown

in FIGURE 1. To close the switch **30**, the rod **116** is rotated in the direction of arrow **120** in FIGURE 2, until the end portion **118** of the rod **116** is completely out of the notch **84** of the rotor **34**. The spring **36** then rotates the rotor **34** in the direction of arrow **104** in FIGURE 2 to snap the side **86***a* of the elongated notch **86** against the stop boss **70**, and thereby close the switch **30**.

In the closed position of the switch **30** of the present invention, the top cover contacts **56** are electrically connected to the bottom cover contacts **74** by the rotor contacts **72** through both the springs **94** and the sleeves **90**. Thus, there is provided two parallel paths electrically connecting each pair of contacts **56** and **74**. Since it is well known that the resistance value of two electrical resistors connected in parallel is less than the resistance value of either of the resistors individually, the switch **30** of the present invention provides low resistance connections between the contacts **56** and the contacts **74**.

Referring to FIGURES 9–15, a modification of the switch of the present invention is generally designated as **122**. Switch **122** comprises a casing **124**, a pair of rotors **126** and **128** rotatably mounted within the casing **124**, and a spring **130** for actuating the rotors **126** and **128**. The casing **124**, and the rotors **126** and **128** are made of an electrically insulating material, such as a plastic.

Casing **124** comprises a top cover **132** and a bottom cover **134**. Top cover **132** comprises a circular disc having a circular recess **136** in the center of the bottom surface of the top cover **132**. A circular recess **138** of a diameter smaller than the diameter of the recess **136** is provided in the center of the flat bottom surface **140** of the recess **136**, and a hole **142** extends through the top cover **132** from the center of the bottom of the recess **138**. Top cover **132** has a narrow annular flange **144** extending downwardly from the bottom surface of the top cover **132** around the outer edge of the bottom surface of the top cover **132**. The top cover **132** has an integral stop boss **146** extending downwardly from the bottom surface **140** of the recess **136** at the outer wall of the recess **136**. A pair of holes **148** extend through the top cover **132** between the outer wall of the recess **136** and the peripheral edge of the top cover **132**, and adjacent diametrically opposite sides of the top cover **132**. Each of the holes **148** is provided with a counterbore **150** at the top surface of the top cover **132**. The top cover **132** has a pair of pockets **152** and **154** in its bottom surface, which pockets **152** and **154** open into the outer wall of the recess **136**. The pockets **152** and **154** are spaced apart circumferentially around the recess **136**. Each of the pockets **152** and **154** is narrower at one end than at the other end, and the adjacent ends of the pockets **152** and **154** are the narrower ends.

Bottom cover **134** comprises a circular disc having a circular recess **156** in the center of its top surface, which recess **156** is of a diameter equal to the diameter of the recess **136** in the top cover **132**. A recess **158**, which is of a diameter equal to the recess **138** in the top cover **132**, is provided in the center of the flat bottom surface **160** of the recess **156**. A hole **162** extends through the bottom cover **134** from the bottom of the recess **158**. Bottom cover **134** has a narrow annular groove **164** in its top surface around the outer edge of the top surface. The groove **164** is of a width and depth equal to the width and depth of the annular flange **144** of the top cover **132**. Bottom cover **134** has a pair of threaded holes **166** therethrough between the outer wall of the recess **156** and the peripheral edge of the bottom cover **134**, and adjacent diametrically opposite sides of the bottom cover **134**. Bottom cover **134** also has a pair of pockets in its top surface which open into the outer wall of the recess **156**. The pockets in the bottom cover **134** correspond in shape, size, and position to the pockets **152** and **154** in the top cover **132**.

The top cover **132** of the casing **124** seats on the bottom cover **134** of the top cover **132** fitting in the annular groove **164** in the bottom cover **134**. The holes **148** in the top cover **132** are aligned with the threaded holes **166** in the bottom cover **134**, and cap screws **168** extend through the holes **148** and are threaded into the holes **166** to secure the top cover **132** and the bottom cover **134** together. The heads of the cap screws **168** fit in the counterbores **150** of the holes **148**. When the top cover **132** and bottom cover **134** are secured together by the cap screws **168**, the pockets **152** and **154** in the top cover **132** are in alignment with the corresponding pockets in the bottom cover **134**.

The top cover **132** is provided with a plurality of contacts **170** of electrically conductive metal which extend through the top cover **132** from the bottom surface **140** of the recess **136** to the top surface of the top cover **132**. The contacts **170** are identical in construction to the contacts **56** in the top cover **38** of the switch **30** previously described. The switch **122** is shown as having ten contacts **170** which are arranged in spaced relation around the circumference of two concentric circles. The bottom cover **134** is also provided with contacts which are similar in construction to the contacts **74** in the bottom cover **40** of the switch **30**. The contacts in the bottom cover **134** are equal in number to the number of contacts **170** in the top cover **132**, and are positioned to be directly opposed to the contacts **170** across the space between the bottom surfaces **140** and **160** of the recesses **136** and **156**.

Rotor **126** comprises a flat, disc-shaped hub **172** which is of a diameter equal to the diameter of the recess **138** in the top cover **132**. A flange **174** extends radially from the outer edge of the hub **172**. The flange **174** extends around approximately 230 degrees of the hub **172**. As shown in FIGURE 13, the top surface of the flange **174** is offset downwardly from the top surface of the hub **172** by a distance equal to the depth of the recess **138** in the top cover **132** from the bottom surface **140** of the recess **136**. The flange **174** projects from the hub **172** a distance equal to the distance between the outer wall of the recess **138** and the outer wall of the recess **136** in the top cover **132**. The flange **174** is of a thickness equal to the distance between the bottom surfaces **140** and **160** of the recesses **136** and **156**. The hub **172** has an annular groove **176** in its bottom surface, and a hole **178** extends through the hub **172** from the bottom of the groove **176**. The flange **174** has eight holes **180** therethrough which are spaced to correspond with the spacing between eight of the contacts **170** in the top cover **132**. The flange **174** has a notch **182** in its outer periphery adjacent one end of the flange **174**.

Rotor **128** comprises a flat circular hub **184** of a diameter corresponding to the diameter of the hub **172** of the rotor **126**. A flange **186** projects radially from the hub **184**. The flange **186** extends around approximately fifty degrees of the hub **184**. As shown in FIGURE 13, the bottom surface of the flange **186** is offset upwardly from the bottom surface of the hub **184** by a distance equal to the depth of the recess **158** in the bottom cover **134** from the flat surface **160** of the recess **156**. The flange **186** extends from the hub **184** a distance equal to the distance between the outer wall of the recess **158** and the outer wall of the recess **156** in the bottom cover **134**, and the flange **186** is of a thickness equal to the distance between the bottom surfaces **140** and **160** of the recesses **136** and **156**. The hub **184** has an annular groove **188** in its top surface, and a hole **190** extending therethrough from the bottom of the annular groove **188**. The flange **186** has a pair of holes **192** therethrough, and a notch **194** in its outer edge.

The rotor **128** is positioned within the casing **124** with the hub **184** rotatably seated within the recess **158** in the bottom cover **134**, and the flange **186** extending within the space formed by the recesses **136** and **156** in the top cover **132** and bottom cover **134** respectively. The

rotor 126 is mounted within the casing 124 with the hub 172 seated on top of the hub 184 of the rotor 128, and rotatably seated in the recess 138 in the top cover 132. The flange 174 of the rotor 126 extends within the space formed by the recesses 136 and 156 of the top cover 132 and bottom cover 134 respectively. The flange 186 of the rotor 128 fits between the ends of the flange 174 of the rotor 126, as shown in FIGURES 9 and 10. The boss 146 on the top cover 132 extends between one end of the flange 174 of the rotor 126 and the flange 186 of the rotor 128.

Each of the rotors 126 and 128 is provided with contacts for electrically connecting the contacts 170 of the top cover 132 and the contacts of the bottom cover 134. The rotor contacts are provided in the holes 180 in the flange 174 of the rotor 126, and the holes 192 in the flange 186 of the rotor 128. The rotor contacts each comprises a sleeve 90, as shown in FIGURE 6, which fits in the holes 180 and 192, a pair of cup-shaped contacts 92 which slidably fit within the sleeve 90, and a spring 94 compressed between the contacts 92 to urge the contacts 92 outwardly from the sleeve 90.

The spring 130, which is a helically coiled spring, is positioned within the annular grooves 176 and 188 in the hubs 172 and 184 of the rotors 126 and 128 respectively. One end 196 of the spring 130 is bent longitudinally upwardly and extends through the hole 178 in the hub 172 of the rotor 126. The other end 198 of the spring 130 is bent longitudinally of the spring and extends through the hole 190 in the hub 184 of the rotor 128. When the ends 196 and 198 of the spring 130 are positioned within the holes 178 and 190 of the rotors 126 and 128, the spring ends 196 and 198 are moved circumferentially away from their normally relaxed position to place the spring 130 under a torsional tension. The torsional tension in the spring 130 normally tends to rotate the rotors 126 and 128 in opposite directions toward the boss 146. Thus, the flange 174 and 186 of the rotors 126 and 128 are normally held against the boss 146 by the spring 130. When the flanges 174 and 186 of the rotors 126 and 128 are positioned against the boss 146, the holes 180 and 192 in the flanges 174 and 186 are positioned in direct alignment between the contacts 170 of the top cover 132 and the contacts of the bottom cover 134. Thus, the contacts 170 in the top cover 132 are electrically connected to the contacts in the bottom cover 134 by the contacts 92 within the holes 180 and 192 of the flanges 174 and 186 of the rotors 126 and 128, and the switch 122 is in its closed position.

To open the switch 122, the rotors 126 and 128 are rotated to move the flanges 174 and 186 away from the boss 146 until the holes 180 and 192 in the flanges 174 and 186 are out of alignment with the contacts of the top cover 132 and bottom cover 134. To accomplish this, the bottom cover 138 is provided with a pair of holes 200 and 202 which extend in opposite directions through the bottom cover 134 from the outer peripheral surface thereof at an angle to the diameter of the bottom cover 134. The holes 200 and 202 open into the recess 156 in the bottom cover 134 just below the boss 146 of the top cover 132. The hole 200 is angled with the longitudinal axis of the hole 200 extending toward the end of the flange 174 of the rotor 126. The hole 202 is angled so that the longitudinal axis of the hole 202 extends toward the end of the flange 186 of the rotor 128. To rotate the rotor 126 to the open position of the switch 122, a rod 204 is inserted through the hole 200 until the end of the rod 204 engages the end of the flange 174 of the rotor 126. By pushing the rod 204 in the direction of the arrow 206 in FIGURE 14, the rotor 126 is rotated. To rotate the rotor 128 to the open position of the switch 122, the rod 204 is inserted through the hole 202 until the end of the rod engages the flange 186 of the rotor 128. By pushing the rod 204 in the direction of the arrow 208, the rotor 128 is rotated.

To maintain the switch 122 in its open position, a separate metal ball 210 is provided in each of the pockets 152 and 154. The balls 210 are each of a diameter larger than the width of the narrower ends of the pockets 152 and 154, but smaller than the width of the wider ends of the pockets 152 and 154. Thus, when the balls 210 are in the narrower ends of the pockets 152 and 154, the balls 210 will project slightly out of the pockets and into the spaced formed by the recesses 136 and 156 in the top cover 132 and bottom cover 134 respectively. However, when the balls 210 are in the wider end of the pockets 152 and 154, the balls 210 will be completely within the pockets. A hole 212 extends through the top cover 132 from the outer periphery of the top cover 132 to the wider end of the pocket 152. The hole 212 is angled so that the longitudinal axis of the hole 212 extends substantially toward the narrower end of the pocket 152. A similar hole extends through the top cover 132 to the wider end of the pocket 154. The top cover 132 and the bottom cover 134 are provided with aligned holes 214 and 216 therethrough which extend across the side of the pocket 152 adjacent the outer periphery of the casing 124, and which are positioned between the ends of the pocket 152. The top cover 132 and bottom cover 134 are provided with a similar pair of aligned holes which extend across the pocket 154. A separate actuating rod 218 extends through and is rotatable in the holes 214 and 216. The end of each of the rods 218 is cut away longitudinally to provide a semi-cylindrical end portion 220 which extends across the pockets 152 and 154 respectively.

To lock the rotor 128 in its open position, the rotor 128 is rotated by means of the rod 204 until the notch 194 in the edge of the flange 186 is juxtaposed to the narrower end of the pocket 152. A rod 222 is inserted through the hole 212 until the end of the rod 222 engages the ball 210 within the pocket 152. The rod 222 is pushed forwardly in the direction of arrow 224 in FIGURE 14 to push the ball 210 into the narrower end of the pocket 152. When the ball 210 is within the narrower end of the pocket 152, the ball 210 projects from the pocket 152 into the notch 194 in the flange 186 of the rotor 128. The actuating rod 218 is then rotated until the end 220 of the actuating rod 218 extends across the width of the pocket 152 as shown in FIGURE 14. In this position of the actuating rod 218, the end 220 of the actuating rod 218 engages the ball 210 and holds the ball 210 within the notch 194 in the flange 186 of the rotor 128. Thus, the rotor 128 is secured by the ball 210 and the actuating rod 218 in the open position of the switch 122. The rotor 126 is similarly locked in its open position by the ball 210 within the pocket 154 extending into the notch 182 in the flange 174 of the rotor 126, and the end 220 of the actuating rod 218 locking the ball 210 against the flange 174, as shown in FIGURE 9.

To close the switch 122, the actuating rods 218 are rotated until the ends 220 of the actuating rods 218 are out of contact with the balls 210. The balls 210 are then free to move along the pockets 152 and 154 to the wider ends of the pockets. The spring 130 then rotates the rotors 128 and 126 in opposite directions as indicated by the arrows 226 and 228 in FIGURE 15 to snap the flanges 186 and 174 of the rotors 128 and 126 against the boss 146, and thereby close the switch 122. When the flanges 186 and 174 of the rotors 128 and 126 are rotated towards the boss 146, the balls 210 are thrown away from the flanges 184 and 174 into the wider ends of the pockets 152 and 154. By rotating both of the actuating rods 218 simultaneously, all of the contacts of the switch 122 can be closed simultaneously. However, by actuating one of the actuating rods 218 before the other, the rotor 126 can be released before or after the rotor 128 so that the rotor 126 will close its contacts before or after the rotor 128 closes its contacts. Thus, the switch 122 of the present invention can be used to close a plurality of circuits simultaneously, or to close some circuits just before other circuits. Although the flange 186 of the

rotor 128 is shown as being much smaller than flange 174 of the rotor 126, the flanges of the rotors can be varied in size to carry a desired number of contacts for controlling a desired number of circuits.

Referring to FIGURES 16–24, another modification of the switch of the present invention is generally designated as 230. Switch 230 comprises a casing 232, a pair of rotors 234 and 236 rotatably mounted within the casing 232, and a spring 238 for actuating the rotors 234 and 236. The casing 232, and the rotors 234 and 236 are made of an electrical insulating material such as a plastic.

Casing 232 comprises a top cover 240 and a bottom cover 242. Top cover 240 comprises a circular disc having a circular recess 244 in the center of its bottom surface. A circular recess 246 of a diameter smaller than the diameter of the recess 244 is provided in the center of the flat bottom surface 248 of the recess 244, and a hole 250 extends through the top cover 240 from the center of the bottom of the recess 246. Top cover 240 has a narrow annular groove 252 in its bottom surface around the outer edge of the bottom surface.

Top cover 240 has a plurality of contact receiving cavities 254 in its bottom surface. Each of the cavities 254 extends outwardly from the outer wall of the recess 246 along a line which is at a small angle to a radius of the top cover 240. A separate hole 256 extends through the top cover 240 from the top surface thereof to each of the cavities 254 adjacent the outer end of the cavity 254. Each of the holes 256 has a counterbore 258 at the top surface of the top cover 240. A separate contact 260 comprising a strip of an electrically conductive metal is provided in each of the cavities 254. One end of each of the contacts 260 is secured to the top cover 240 by an eyelet 262 of an electrically conductive metal. Each of the eyelets 262 extends through and is secured in a hole 256. The inner end of each of the contacts 260 extends along the bottom surface 248 of the recess 244.

Bottom cover 242 comprises a circular disc having a circular recess 264 in the center of its top surface, which recess 264 is of a diameter equal to the diameter of the recess 244 in the top cover 240. A recess 266, which is of a diameter equal to the recess 246 in the top cover 240, is provided in the center of the flat bottom surface 268 of the recess 264. A hole 269 extends through the bottom cover 242 from the bottom of the recess 266. Bottom cover 242 has a narrow annular flange 270 projecting upwardly from its top surface around the outer edge of the bottom cover 242. The flange 270 is of a width and depth equal to the width and depth of the annular groove 252 in the top cover 240. The bottom cover 242 has an integral stop boss 272 extending upwardly from the bottom surface 268 of the recess 264 at the outer wall of the recess 264.

The bottom cover 242 is provided with a plurality of contact receiving cavities which correspond in shape, size, and number to the cavities 254 in the top cover 240. A separate hole 274 extends through the bottom cover 242 from the bottom surface thereof to the outer end of each of the contact receiving cavities. Each of the holes 274 has a counterbore 276 at the bottom surface of the bottom cover 242. A separate contact 278 comprising a strip of an electrically conductive metal is provided in each of the contact receiving cavities in the bottom cover 242. The outer end of each of the contacts 278 is secured to the bottom cover 242 by an eyelet of an electrically conductive metal which extends through and is secured in the hole 274. The inner end of each of the contacts 278 extends along the bottom surface 268 of the recess 264.

The top cover 240 of the casing 232 seats on the bottom cover 242 with the annular flange 270 of the bottom cover 242 fitting in the annular groove 252 in the top cover 240. A pair of cap screws 280 extend through the top cover 240 and are threaded into the bottom cover 242 to secure the top cover 240 and the bottom cover 242 together. The contacts 260 of the top cover 240 and the contacts 278 of the bottom cover 242 are arranged so that the inner end of each of the contacts 260 is directly above the inner end of a contact 278, but the outer ends of the contacts 260 and 278 are circumferentially spaced apart, as shown in FIGURES 16 and 17. As shown, the cover 232 is provided with five sets of the contacts 260 and 278. However, the switch 230 may be provided with any number of sets of contacts according to the number of circuits to be controlled by the switch 230.

Rotor 234 comprises an annular hub 282 of an outer diameter equal to the diameter of the recess 266 in the bottom cover 242. A flange 284 extends radially from the outer edge of the hub 282. As shown in FIGURE 20, the bottom surface of the flange 284 is spaced upwardly from the flat bottom surface of the hub 282 a distance equal to the depth of the recess 266 in the bottom cover 242 from the bottom surface 268 of the recess 264. The flange 284 projects from the hub 282 a distance equal to the distance between the outer wall of the recess 266 and the outer wall of the recess 264 in the bottom cover 242. The flange 284 is of a thickness equal to the distance between the bottom surfaces 268 and 248 of the recesses 264 and 246. The hub 282 has an annular groove 286 in its top surface. The flange 284 is provided with four circumferentially spaced contacts 288 extending therethrough. As shown in FIGURE 23, each of the contacts 288 has an enlarged head 290 at each end thereof. The outer surfaces of the heads 290 are flush with the surfaces of the flange 284. The contacts 288 are spaced apart to correspond with the spacing between four of the sets of contacts of the housing 232. The flange 284 extends around substantially two hundred and thirty degrees of the hub 286, and has a notch 292 in its outer edge adjacent one end thereof.

Rotor 236 comprises an annular hub 294 of a diameter corresponding to the diameter of the hub 286 of the rotor 234. A flange 296 projects radially from the hub 294. The flange 296 extends around approximately fifty degrees of the hub 294. As shown in FIGURE 20, the top surface of the flange 296 is offset downwardly from the top surface of the hub 294 by a distance equal to the depth of the recess 246 in the top cover 240 from the flat surface 248 of the recess 244. The flange 296 extends from the hub 294 a distance equal to the distance between the outer wall of the recess 246 and the recess 244, and the flange 296 is of a thickness equal to the distance between the bottom surfaces 248 and 268 of the recesses 244 and 266. The hub 294 has an annular groove 298 in its bottom surface. The flange 296 has a contact 300 therethrough which is similar to the contacts 288. The flange 296 has a notch 302 in its outer edge adjacent one end thereof.

The rotor 234 is positioned within the casing 232 with the hub 282 rotatably seated within the recess 266 in the bottom cover 242, and the flange 284 extending within the space formed by the recesses 246 and 264 in the top cover 240 and bottom cover 242 respectively. The rotor 236 is mounted within the casing 232 with the hub 294 seated on top of the hub 282 of the rotor 234, and rotatably seated in the recess 246 in the top cover 240. The flange 296 of the rotor 236 extends within the space formed by the recesses 244 and 264 in the top cover 240 and bottom cover 242 respectively. The flange 296 of the rotor 236 fits between the ends of the flange 284 of the rotor 234, as shown in FIGURES 16 and 17. The boss 272 on the bottom cover 242 extends between one end of the flange 284 of the rotor 234 and the flange 296 of the rotor 236.

The spring 238 comprises a flat strip of spring metal wound upon itself in a spiral. The spring 238 is positioned within the annular grooves 286 and 298 in the hubs 282 and 294 of the rotors 234 and 236 respectively. As shown in FIGURE 21, the inner end of the spring 238 is

provided with a radially inwardly extending flange 304 which extends into a slot 306 in the hub 294 of the rotor 236. The outer end of the spring 238 is provided with an outwardly projecting flange 308 which fits into a slot 310 in the hub 282 of the rotor 234. When the flanges 304 and 308 of the spring 238 are positioned within the slots 306 and 310, the ends of the spring 238 are moved circumferentially away from their normal relaxed position to place the spring 238 under a torsional tension. The torsional tension in the spring 238 normally tends to rotate the rotors 234 and 236 in opposite directions toward the stop boss 272. Thus, the flanges 284 and 296 of the rotors 234 and 236 are normally held against the stop boss 272 by the spring 238 as shown in FIGURE 17. When the flanges 284 and 296 of the rotors 234 and 236 are positioned against the stop boss 272, each of the contacts 288 and 300 carried by the flanges 284 and 296 is positioned in direct alignment between the inner end of a contact 260 carried by the top cover 240 and the inner end of a contact 278 carried by the bottom cover 242. The contacts 260 and 278 are tensioned so that the inner ends of the contacts 260 and 278 slidingly engage the surfaces of either the flange 284 of the rotor 234 or the flange 296 of the rotor 236. Thus, when the rotors 234 and 236 are positioned so that the contacts 288 and 300 are each directly between a pair of casing contacts 260 and 278, each of the rotor contacts 288 and 300 electrically connects a casing contact 260 to a casing contact 278, and the switch 230 is in its closed position.

To open the switch 230, the rotors 234 and 236 are rotated to move the flanges 284 and 296 away from the stop boss 272 until the contacts 288 and 300 are out of alignment with the casing contacts 260 and 278, as shown in FIGURE 16. To accomplish this, the top cover 240 is provided with a pair of folds 312 and 314 which extend in opposition directions through the top cover 240 from the outer peripheral surface thereof at an angle to the diameter of the top cover 240. The holes 312 and 314 open into the recess 244 in the top cover 240 just above the stop boss 272 as shown in FIGURE 24. The hole 312 is angled with the longitudinal axis of the hole 312 extending toward the end of the flange 284 of the rotor 234, and the hole 314 is angled so that the longitudinal axis of the hole 314 extends toward the end of the flange 296 of the rotor 236. To rotate the rotor 234 to the open position of the switch 230, a rod 316 is inserted through the hole 312 until the end of the rod 316 engages the end of the flange 284 of the rotor 234. By pushing the rod 316 in the direction of the arrow 318 in FIGURE 24, the rotor 234 is rotated. To rotate the rotor 236 to the open position of the switch 230, the rod 316 is inserted through the hole 314 until the end of the rod engages the flange 296 of the rotor 236. By pushing the rod 316 in the direction of the arrow 320, the rotor 236 is rotated.

To maintain the switch 230 in its open position, the casing 232 is provided with an opening 320 extending radially through the top cover 240 and the bottom cover 242 from the outer peripheries of the covers 240 and 242, and opening into the recesses 244 and 264. The opening 320 is positioned so that when the rotors 234 and 236 are in their switch open position, the notches 292 and 302 in the flanges 284 and 296 of the rotors 234 and 236 are juxtaposed to the opening 320. A pair of actuating rods 322 and 324 extend through the opening 320 in the casing 232. The actuating rod 322 extends into the notch 292 in the flange 284 of the rotor 234, and holds the rotor 234 in its switch open position. The actuating rod 324 extends into the notch 302 in the flange 296 of the rotor 236, and holds the rotor 236 in its switch open position, as shown in FIGURE 16. To close the switch 230, the actuating rods 322 and 324 are moved radially outwardly in the direction of the arrows 326 in FIGURE 17 to remove the actuating rods 322 and 324 from the notches 292 and 302 in the flanges 284 and 296 of the rotors 234 and 236. When the rotors 234 and 236 are released, the spring 238 rotates the rotors 234 and 236 in opposite directions to snap the flanges 284 and 296 against the stop boss 272, and thereby close the switch 230.

By removing both of the actuating rods 322 and 324 simultaneously from the rotors 234 and 236, all of the contacts of the switch 320 can be closed simultaneously. However, by actuating one of the actuating rods before the other, the rotor 234 can be released before or after the rotor 236 so that the rotor 234 will close its contacts before or after the rotor 236 closes its contact. Thus, the switch 230 of the present invention can be used to close a plurality of circuits simultaneously, or to close some circuits just before other circuits. Although the flange 296 of the rotor 236 is shown as being much smaller than the flange 284 of the rotor 234, the flanges of the rotors can be varied in size to carry a desired number of contacts for controlling a desired number of circuits.

The present invention may be embodied in other specific forms without departing from the spirit or essential attributes thereof and, accordingly, reference should be made to the appended claims, rather than to the foregoing specification as indicating the scope of the invention.

We claim:

1. A switch comprising a casing of an electrical insulating material, said casing having a cavity therein which is defined by a pair of spaced parallel flat surfaces and a cylindrical surface extending between said flat surfaces, a pair of contacts carried by said casing, one of said contacts having a surface extending along and flush with one of said flat surfaces and the other contact having a surface extending along and flush with the other flat surface directly opposite the surface of said one contact, a rotor of an electrical insulating material rotatably mounted within said cavity, said rotor engaging the flat and cylindrical surfaces of the cavity so as to be supported by the surfaces of the cavity a contact extending through and carried by said rotor, said rotor being rotatable between a closed position in which the rotor contact simultaneously engages said casing contacts and an open position in which the rotor contact is angularly displaced from the casing contacts, spring means adapted to snap said rotor from its open position to its closed position and normally holding said rotor in its closed position, means whereby the rotor can be rotated to its open position, said spring means being under tension when the rotor is in its open position, and means for releasably securing the rotor in its open position.

2. A switch comprising a casing of an electrical insulating material, said casing having a cavity therein which is defined by a pair of spaced parallel flat surfaces and a cylindrical surface extending between said flat surfaces, a pair of contacts carried by said casing, one of said contacts having a surface extending along one of said flat surfaces and the other contact having a surface extending along the other flat surface directly opposite the surface of said one contact, a rotor of an electrical insulating material rotatably mounted within said cavity, a contact extending through and carried by said rotor, said rotor contact comprising a sleeve of electrically conductive metal extending through the rotor, a pair of cup-shaped contact members of electrically conductive metal slidably disposed within said sleeve and engaging said sleeve, said contact members having the same outer diameter with their open ends facing each other, a helical spring within said sleeve and comprised between said contact members, said rotor being rotatable between a closed position in which the rotor contact simultaneously engages said casing contacts and an open position in which the rotor contact is angularly displaced from the casing contacts, spring means adapted to snap said rotor from its open position to its closed position and normally holding said rotor in its closed position,

means whereby the rotor can be rotated to its open position, said spring means being under tension when the rotor is in its open position, a means for releasably securing the rotor in its open position.

3. A switch in accordance with claim 1 in which the casing has a plurality of pairs of opposed contacts spaced around the flat surfaces, and the rotor has a plurality of spaced contacts extending therethrough, each of said rotor contacts electrically connecting a pair of casing contacts when the rotor is in its closed position.

4. A switch in accordance with claim 1 in which the casing has a stop boss extending into the cavity from the cylindrical wall, the rotor has a surface for engaging said stop boss to limit the rotation of the rotor, said stop boss being positioned so that when the surface of the rotor engages the stop boss the rotor is in its closed position, and the spring normally holds said rotor against said stop boss.

5. A switch comprising a casing of an electrical insulating material, said casing having a cavity therein which is defined by a pair of spaced parallel flat surfaces and a cylindrical surface extending between said flat surfaces, a stop boss extending into the cavity from the cylindrical wall thereof; a pair of contacts carried by said casing, one of said contacts having a surface extending along one of said flat surfaces and the other contact having a surface extending along the other flat surface directly opposite the surface of said one contact; a rotor of an electrical insulating material rotatably mounted within said cavity, a contact extending through and carried by said rotor, said rotor being rotatable between a closed position in which the rotor contact simultaneously engages said casing contacts and an open position in which the rotor contact is angularly displaced from the casing contacts, said rotor having a surface extending substantially radially with respect to the axis of rotation of said rotor for engaging said stop boss to limit the rotation of the rotor, said stop boss being positioned so that when the radial surface of the rotor engages the stop boss the rotor is in its closed position; spring means adapted to snap said rotor from its open position to its closed position and normally holding the rotor against said stop boss; means whereby the rotor can be rotated to its open position comprising a hole extending through said casing to the cylindrical wall of the cavity with the inner end of said hole being adjacent to said stop boss, the longitudinal axis of said hole being substantially perpendicular to said radial surface of the rotor when the rotor is in its closed position, said hole being adapted to receive a rod which engages said radial surface of the rotor to rotate said rotor to its open position, said spring means being under tension when the rotor is in its open position; and means for releasably securing the rotor in its open position.

6. A switch comprising a casing of an electrical insulating material, said casing having a cavity therein which is defined by a pair of spaced parallel surfaces and a cylindrical surface extending between said flat surfaces, a pair of contacts carried by said casing, one of said contacts having a surface extending along one of said flat surfaces and the other contact having a surface extending along the other flat surface directly opposite the surface of said one contact, a rotor of an electrical insulating material rotatably mounted within said cavity said rotor having a notch in its outer periphery, a contact extending through and carried by said rotor said rotor being rotatable between a closed position in which the rotor contact simultaneously engages said casing contacts and an open position in which the rotor contact is angularly displaced from the casing contacts, spring means adapted to snap said rotor from its open position to its closed position and normally holding said rotor in its closed position, means whereby the rotor can be rotated to its open position, said spring means being under tension when the motor is in its open position, a means for releasably securing the rotor in its open position including means projecting from the cylindrical wall of the cavity in said rotor and extending into the notch in the rotor when the rotor is in its open position, said releasing means being moveable out of said notch to release said rotor.

7. A switch in accordance with claim 6 in which the casing has a hole extending therethrough along the cylindrical wall, a portion of said hole opening into the cavity, and the means for releasably securing the rotor in its open position comprises a rod extending through and rotatable in said hole, said rod being rotatable between a position in which a portion of said rod extends into the notch in the rotor when the rotor is in its open position to secure the rotor in its open position and a position in which the rod is out of said notch to release said rotor.

8. A switch in accordance with claim 6 in which the casing has a pocket extending outwardly from the cylindrical wall, one end of said pocket being deeper than the other end of said pocket, and the means for releasably securing the rotor in its open position includes a ball within said pocket, said ball being of a diameter larger than the depth of the shallower end of said pocket but smaller than the depth of the deeper end of said pocket, said ball adapted to project from the shallower end of said pocket into the notch in said rotor when the rotor is in its open position, and means for releasably securing the ball in the shallower end of said pocket.

9. A switch in accordance with claim 1 in which the casing is divided transversely across the cavity to provide a top cover member and a bottom cover member, and means for securing said cover members together.

10. A switch comprising a casing of an electrical insulating material, said casing having a cavity therein which is defined by a pair of spaced parallel flat surfaces and a cylindrical surface extending between said flat surfaces, a plurality of pairs of opposed contacts carried by said casing, one contact of each pair having a surface extending along one of said flat surfaces and the other contact of each pair having a surface extending along the other flat surface, a pair of rotors of electrical insulating material rotatably mounted within said cavity, each of said rotors comprising a hub and a flange extending radially from said hub, the flange of each of said rotors extending less than completely around its hub, the total circumferential extent of both of said flanges being less than 360 degrees, the rotors being positioned in the cavity with one of the hubs being seated on the other hub and the flange of one rotor being disposed between the ends of the flange of the other rotor, at least one contact extending through and carried by the flange of each of said rotors, each of said rotors being rotatable between a closed position in which the rotor contacts each electrically connect a separate pair of said casing contacts and an open position in which the rotor contacts are angularly spaced from said casing contacts, spring means adapted to snap said rotors from their open positions to their closed positions and normally holding said rotors in their closed position, means whereby the rotors can be rotated to their open position, said spring means being under tension when the rotors are in their open positions, and means for releasably securing the rotors in their open position.

11. A switch in accordance with claim 10 in which the casing has a stop boss extending into the cavity from the cylindrical wall, each of the flanges of the rotors has an end surface which is adapted to engage the stop boss to limit rotation of said rotors, said stop boss being positioned so that when the flanges of the rotors engage said stop boss the rotors are in their closed position, and the spring normally holds said flanges against the stop boss.

12. A switch in accordance with claim 11 in which the end surfaces of the flanges of the rotors which engage the stop boss extend substantially radially with respect to the axis of rotation of said rotors, and the means

whereby each of the rotors can be rotated to its open position comprises a separate hole extending through said casing to the cylindrical wall with the inner end of each of said holes being adjacent said stop boss, the longitudinal axis of each of said holes being substantially perpendicular to a separate one of said end surfaces when the rotors are in their closed position, said holes being adapted to receive a rod which engages said end surfaces of the flanges of said rotors to rotate said rotors to their open position.

13. A switch in accordance with claim 10 in which the flange of each of the rotors has a notch in its outer periphery, and the means for releasably securing the rotors in their open position includes means projecting from the cylindrical wall and extending into the notches when the rotors are in their open position.

14. A switch in accordance with claim 10 in which the hubs of the rotors have opposed annular grooves in their mating surfaces, and the spring means comprises a spring wound within said annular grooves, one end of said spring extending through a hole in one of said hubs and the other end of said spring extending through a hole in the other hub.

15. A switch in accordance with claim 10 in which each flat surface of the casing has a circular recess in the center thereof, and the hub of each of the rotors rotatably fits into a separate one of said recesses.

16. A switch in accordance with claim 10 in which the casing is divided transversely across the cavity to provide a top cover member and a bottom cover member, and means securing said cover members together.

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