

Aug. 10, 1954

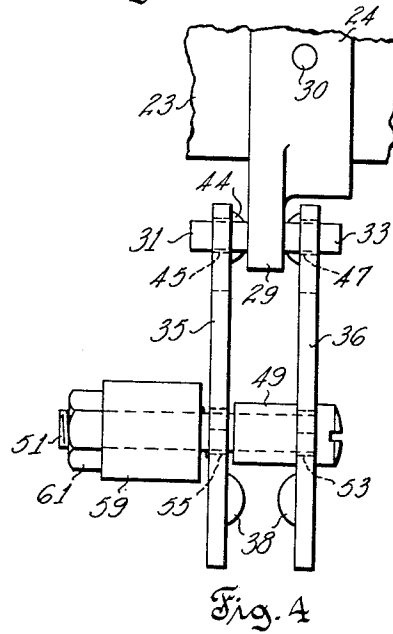
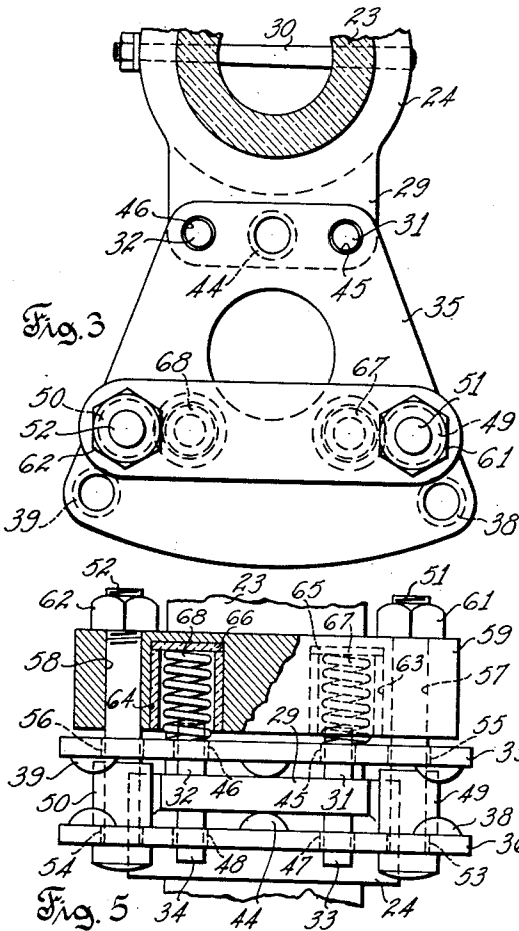
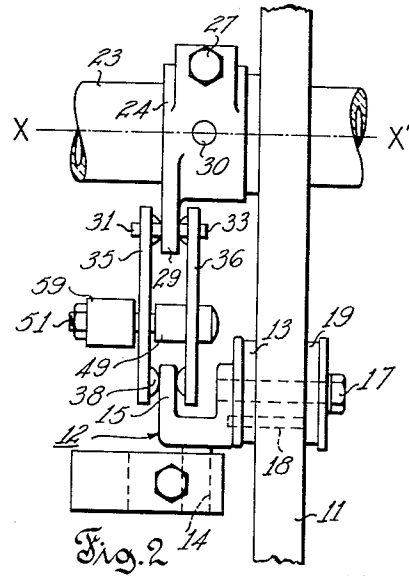
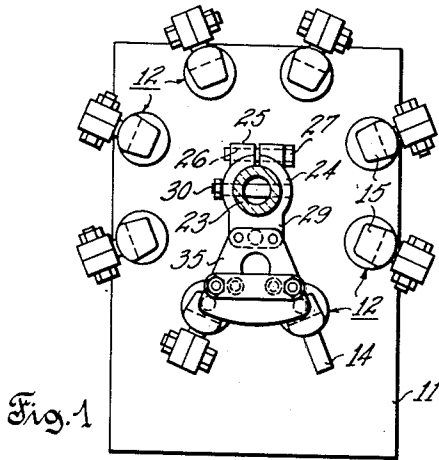
J. B. HODTUM

2,686,236

ROTARY SWITCH WITH THREE-POINT CONTACT SUPPORT

Filed April 5, 1952

2 Sheets-Sheet 1



Inventor
Joseph B. Hodtum
by Joseph E. Kerwin
Attorney

Aug. 10, 1954

J. B. HODTUM

2,686,236

ROTARY SWITCH WITH THREE-POINT CONTACT SUPPORT

Filed April 5, 1952

2 Sheets-Sheet 2

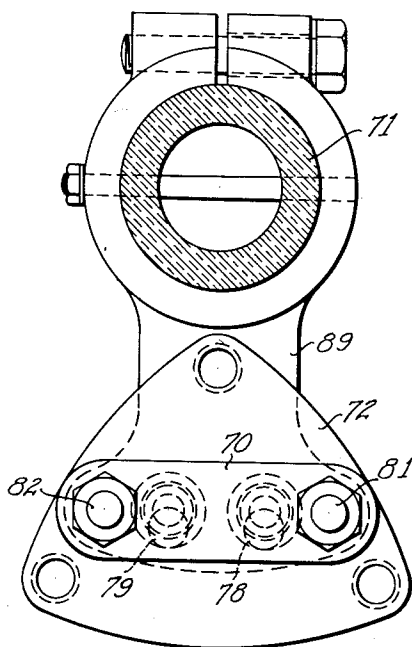


Fig. 6

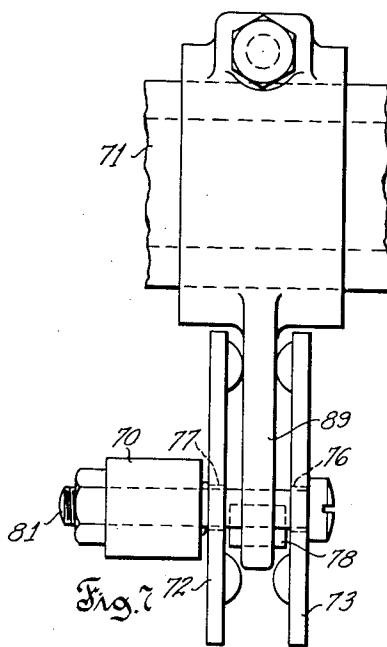


Fig. 7

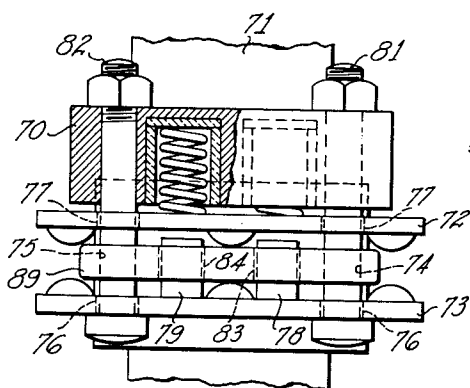


Fig. 8

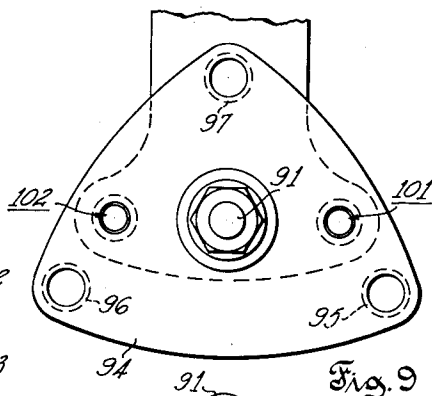


Fig. 9

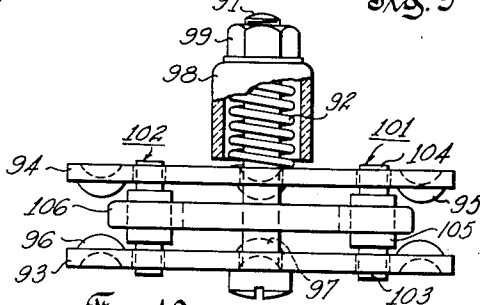


Fig. 10

Inventor
Joseph B. Hodtum
by Joseph E. Kerwin
Attorney

UNITED STATES PATENT OFFICE

2,686,236

ROTARY SWITCH WITH THREE-POINT
CONTACT SUPPORTJoseph B. Hodtum, Pittsburgh, Pa., assignor to
Allis-Chalmers Manufacturing Company, Milwaukee, Wis.

Application April 5, 1952, Serial No. 280,711

13 Claims. (Cl. 200—11)

1

This invention relates to electrical switches, and in particular to an improvement in switches having rotary wiping members which bridge stationary blades.

In these switches in which the stationary blades are bridged on their upper and lower contact surfaces by a pair of rotating bridging members, the bridging members and the stationary blades must effect good electrical contact regardless of which two adjacent stationary contacts are bridged. Poor electrical connection between the switch elements is likely to result from any misalignments or irregularities of the elements of the switch, and misalignment or irregularities may result from manufacturing tolerances, from wear of parts of the switch or from sludge or carbon which may accumulate on or near the switch elements.

These difficulties can be avoided to some extent in switches which carry relatively small currents by providing flexible or resilient stationary or movable conductive switch elements. However, the maximum current carrying capacity of such flexible or resilient conductive elements is limited, for if the current carried by the contact elements is relatively large, the flexibility and resiliency of the material will be adversely affected by tempering effect resulting from current heating.

Having in mind these difficulties, particularly with respect to switches which carry relatively large currents and which may carry heavy short circuit currents, the rotating assembly of switches embodying this invention is constructed and assembled so that it has contact elements which substantially self-adjust to compensate for any wear or misalignment of switch parts. The rotary movement of the bridging members across the stationary blades is accomplished by operating or driving mechanism to which the bridging members are independently and floatingly connected. The self-adjustment of the contact elements is enhanced by providing three point support of the rotating, bridging members. In addition, the switch is made so that the large magnetic forces caused by relatively large currents flowing through the switch elements will add to the mechanical force applying the bridging members to the stationary blades.

It is therefore an object of this invention to provide a multiple position switch with an improved rotary contact assembly which is self-adjusting with respect to its driving mechanism and with respect to the stationary blades engaged by the rotating assembly.

2

Another object of this invention is to provide a switch in which rigid conductive bridging members are embodied in a rotary contact assembly with the bridging members independently rockable and self-adjusting to insure their proper electrical connection with stationary blades and in which a resilient means unaffected by the current carried by the switch coacts with the bridging members.

Still another object of this invention is to utilize, in an improved multiple position switch having rotary wiper members, the current carried by the switch elements to improve the electrical connection between the conductive switch elements.

Still another object of this invention is to embody self-adjusting and self-positioning features in a rotating assembly of a multiple position switch which is small in size and easy to assemble.

Objects and advantages other than those above set forth will be apparent from the following description when read in connection with the accompanying drawings, in which:

Fig. 1 is a plan view of a multiple position switch illustrating an embodiment of this invention;

Fig. 2 is an elevation view of part of the switch shown in Fig. 1;

Fig. 3 is an enlarged partial plan view of the rotating assembly of the switch shown in Fig. 1;

Fig. 4 is a view in elevation of the assembly shown in Fig. 3;

Fig. 5 is a front elevation, partly in section, of the assembly shown in Fig. 3;

Figs. 6, 7 and 8, respectively, are views similar to Figs. 3, 4 and 5, of a modification of the rotary contact assembly of a switch similar to that shown in Fig. 1; and

Figs. 9 and 10, respectively, are a plan view and a partly sectional front view of another modification of the rotary contact assembly for the switch shown in Fig. 1.

The switch shown in Figs. 1 to 5 has an insulating panel 11 upon which a plurality of stationary contacts 12 of suitable conductive metal are fastened by being substantially uniformly spaced on a full circle or on an arc of a circle. Each stationary contact may be a single piece element comprising a base portion 13, a terminal stud 14 and a blade 15. The blades have substantially flat contact surfaces and chamfered edges which engage the rigid rotating bridging members 35, 36 of the switch. Each stationary contact is fastened to the insulating panel by a bolt 17 which

extends through a hole in the insulating panel and screws into the base portion 13. A suitable means is provided to prevent the stationary contact from turning about the axis of the bolt and is shown as a pin 18 which is inserted through the insulating panel into a recess of the base portion 13. The pin is held in the recess of the base portion and in the insulating panel by being abutted by a washer 19 between the head of bolt 17 and the panel. All the stationary contacts are similarly constructed and assembled so that the surfaces and the median planes of the different blades are spaced substantially uniformly from the panel 11.

The conductive bridging members 35, 36 are rotated by a hollow drive shaft 23 to which they are fastened by connecting means in a manner to provide independent self-adjustment of their respective positions to assure that they make good electrical contact with any of the stationary blades. The bridging members 35, 36, the drive shaft 23 and the connecting means constitutes a rotary contact assembly, in which the axis X-X' of the drive shaft is normal to the surface of the insulating panel 11 and to the median plane of blades 15 and extends through that panel at the center of the arc or circle on which the stationary blades are positioned.

The connecting means between the drive shaft and the bridging members includes driving and driven surfaces which engage to transmit the driving force of the shaft to the bridging members. In this embodiment, there is a laterally extending flat arm 29 fastened to the drive shaft 23 by means of a split yoke clamp 24 which encircles the drive shaft. The split end 25 of the clamp has a threaded hole 26 for receiving a bolt 27 which makes the arm 29 fast on the drive shaft with its median plane substantially coinciding with the median plane of blades 15. A tapered pin 30 is driven through the yoke clamp 24 and the drive shaft to prevent the clamp from slipping along the shaft. The arm carries four drive pins 31, 32, 33 and 34 which extend generally parallel to the shaft. One pair 31, 32 of these pins extends from one face of the arm, while the other pair 33, 34 extends from the opposite face of the arm. These pins provide the driving surfaces. The bridging members are spaced apart along the axis of the drive shaft on opposite sides of the lateral arm and of the median plane of the blades. The driven surfaces defined by holes 45, 46, 47 and 48 in the bridging members are engaged by the corresponding driving surfaces to effect turning of the bridging members in either direction about the axis of the drive shaft. The driving pins have a clearance fit in the holes so that the bridging members are in loose engagement with the pins and are not restrained from moving somewhat or tilting with respect to the arm.

Preferably, the bridging members are flat and are made identical to each other. On the adjacent surfaces of these members there are three protuberances which are formed as spherical buttons triangularly spaced to provide a three point support for each member.

Two of the three protuberances are contact buttons 38, 39 and are equally spaced from the axis of the drive shaft on the arc of the stationary blades to engage the stationary blades as the rotary contact assembly is moved. These two contact buttons are spaced apart on their respective bridging member a distance greater

than the space between adjacent stationary blades so that the two spherical contact buttons simultaneously make point contact with the contact surfaces of adjacent blades. The third protuberance 44 is disposed intermediate the arc of the stationary blades and the drive shaft. It is midway between the two spaced holes which define the driven surfaces of each member. This third protuberance engages the lateral arm.

The stationary blades are disposed intermediate the two bridging members with respect to the axis of the drive shaft, and the opposite surfaces of the arm and the stationary blades are substantially aligned in the axial direction of the shaft so that bridging members extend generally normal to the axis of the shaft.

A biasing means is included in the rotary contact assembly to act on the bridging members to keep the driving and driven surfaces always in position to be engaged and to create a mechanical force causing firm and positive point contact of the protuberances of each bridging member with the stationary blades and with the lateral arm.

The biasing means is preferably disposed in the rotary contact assembly to act on the bridging members within the triangle defined by the protuberances, and is held in its position by retaining means fastened to a connecting link which extends through the bridging member. In the embodiment shown in Figs. 1 to 5 the connecting link is represented by bolts 51, 52, which extend through holes 53, 54 in bridging member 36, collars 48, 49, holes 55 and 56 in bridging member 35, and holes 57, 58 in a housing 59. A suitable locking device, such as nuts 61, 62 is attached to the bolts 51, 52; the locking device and the housing 59 constitute the retaining means for the biasing means. This housing 59 has two recesses 63, 64 which are lined with insulating material 65, 66, and there are two springs 67, 68, respectively, disposed in the recesses 63, 64. The shoulders formed by the heads of the bolts and by the nuts establish lateral surfaces of the connecting link on opposite sides of the bridging members. These lateral surfaces are abutments which cooperate with the springs to force the two bridging members toward each other and to press the bridging members against the contact surfaces of the stationary blades.

The distance between the two bridging members is limited to a predetermined minimum value by stop means in the form of the collars 48, 49 intermediate those members. The ends of these collars constitute lateral surfaces which may abut the adjacent surfaces of the two bridging members. Similarly, the lateral surfaces of the connecting link created by the nuts and heads of the bolts combine with the spring housing to limit the distance between the bridging members to a maximum value. This control of the distance between the adjacent surfaces of the two bridging members to a predetermined range limits the amplitude of oscillation of the springs to a predetermined reasonable range to prevent deterioration of the springs.

In the modified rotary contact assembly illustrated in Figs. 6, 7 and 8, the arm 89 extends a greater distance laterally of the drive shaft 71 than does the arm in the embodiment first described. And the connecting link constituting the two bolts 81, 82 which extends through the two bridging members 72, 73 also extends through holes 74, 75 in the arm. Thus, in this second

embodiment the connecting link not only retains the spring housing 70 and holds one bridging member 72 superposed over the other bridging member 73 but in addition provides the driving surfaces carried by the arm to effect the movement of the bridging members by engaging the wall surfaces defining holes 76, 77 in those members. As in the first embodiment stop means is provided between the two bridging members to maintain a minimum spacing between those two bridging members, and the stop means in this instance preferably comprises cylindrical dowels 78, 79 which are loosely disposed in holes 83, 84 in the lateral shoulder 89. The ends of these dowels may be abutted by the adjacent faces of the two bridging members.

The third embodiment shown in Figs. 9 and 10 differs from the other embodiments primarily in having only one connecting bolt 91 and one spring 92. The connecting bolt extends through the bridging members 93, 94 at the center of the triangle defined by the protuberances 95, 96 and 97. The coil spring, which is disposed in a housing 98 made of suitable insulating material, surrounds the bolt and is retained in its position by the nut type locking device 99. Two dowels 101, 102 are included in the rotary contact assembly. These dowels are spaced from the connecting bolts. The end portions (103, 104 of dowel 101) of each of the dowels are disposed in holes in the bridging members; while intermediate portions (105 of dowel 101) having enlarged diameters and extend through holes in the arm 106. These dowels which are thus carried by the arm are spaced from the connecting bolt and prevent the bridging members from turning about the longitudinal axis of the single connecting bolt, and the lateral end surfaces of the intermediate portions may abut the adjacent surfaces of the bridging members, thereby constituting stop means between the bridging members.

In operation, as the drive shaft and lateral arm fast thereon are rotated about the axis of the drive shaft, the two bridging members are moved by the driving surfaces carried by the lateral arm which engage driven surfaces of the bridging members. The driving means is represented by at least two driving surfaces carried by the arm; the two driving surfaces cooperate to prevent the bridging members from turning with respect to the arm.

The bridging members are not rigidly connected to each other or to their driving means. Each of the bridging members is self-adjusting and will accommodate for any misalignment between any parts of the switching elements. The bridging members are free to move or rock as those members are rotated by the driving shoulder. Each of the bridging members has three point support, and it is substantially impossible for them to poorly or improperly engage with the stationary blades. Biasing means and abutment means are provided to keep the bridging members pressed against those stationary blades and keep the driving and driven surfaces properly positioned to engage. Yet the bias means does not carry current and therefore will not be tempered by current heating. In addition, the fatigue of the resilient bias means is minimized by keeping the oscillations of the resilient member within a predetermined range.

The point of contact between the spherical surfaces of the contact buttons and the flat con-

tact surfaces of the stationary blades enables high contact pressure to be created by both the mechanical force of the biasing means and the magnetic forces of the parallel relatively heavy currents through the two bridging members.

This switch preferably is embodied as a tap changer for a transformer which is disposed in a casing filled with liquid insulation. In such embodiments there may be carbon and sludge formations near the switch engaging surfaces. However, with this improved switch, the point contact between the bridging members and stationary blades results in low contact resistance, high contact pressure and self-cleaning action.

The floating action of the bridging members is very important as it results in a quick, automatic adjustment to give equal pressure on each corner of the triangular bridging members for perfect tap alignment because the resilient member of the bias means acts on the bridging members within the triangularly spaced points of support.

Another feature of this invention involves the stop means against which the adjacent surfaces of the bridging members abut when the distance between those members is reduced to the minimum. This abutment holds the two bridging members in what may be defined as a partially open position when the tap change is being made so that the bridging members will more easily slide on to the next stationary blade.

Although but three embodiments of the present invention have been illustrated and described, it will be apparent to one skilled in the art that various changes and modifications may be made therein without departing from the spirit of the invention or from the scope of the appended claims.

It is claimed and desired to secure by Letters Patent:

1. A switch comprising a panel, a plurality of stationary blades fixed to said panel and uniformly spaced on an arc and a moving contact assembly including two rigid conductive members, each said rigid member having width greater than the space between adjacent said blades to bridge any two adjacent said blades, said rigid members being superposed on opposite sides of the median plane of said blades to provide parallel conductive paths between adjacent said blades, a shaft with its axis of rotation perpendicular to the median plane of said blades disposed at the center of the arc of said blades, said shaft having a member extending laterally of its axis in approximately the median plane of said blades, driving means comprising the sole means connecting said two rigid members with said lateral member whereby said shaft rotates and moves said rigid members, said connecting means comprising a pin fixedly attached to a first of said three members extending therefrom normal to the median plane of said blades and projecting loosely through the other two said members with clearance whereby upon rotation of said shaft said lateral member rotates said rigid members through coacting driving and driven surfaces of said pin and of said other two members and said rigid members are free to rock with respect to each other and with respect to said lateral member, means coacting between said rigid members and said lateral member to prevent said rigid members from turning with respect to said lateral member, and resilient

means independent of said lateral member coacting with said two rigid members to maintain said pin projecting through said other two members with said driving and driven surfaces in position to coact with each other.

2. A switch comprising a panel, a plurality of stationary blades fixed to said panel and uniformly spaced on an arc and a moving contact assembly including two conductive members, each said conductive member having width greater than the space between adjacent said blades to bridge any two adjacent said blades, said conductive members being superposed on opposite sides of the median plane of said blades to provide parallel conductive bridges between adjacent said blades, a shaft with its axis of rotation perpendicular to the median plane of said blades and disposed at the center of the arc of said blades, said shaft having a member extending laterally of its axis, driving means comprising the sole means connecting said two conductive members with said lateral member whereby said shaft rotates and moves said conductive members, said connecting means comprising a pin fixedly attached to a first of said three members extending therefrom normal to the median plane of said blades and projecting loosely through the other two said members with a clearance whereby upon rotation of said shaft said lateral member rotates said conductive members through coacting driving and driven surfaces of said pin and said other two members and said conductive members are free to rock with respect to each other and with respect to said lateral member, means coacting between said conductive members and said lateral member to prevent said conductive members from turning with respect to said lateral member, and resilient means coacting with said two conductive members to maintain said pin projecting through said other two members with said driving and driven surfaces in position to coact with each other.

3. A switch comprising a panel, a plurality of stationary blades fixed to said panel and uniformly spaced on an arc and a moving contact assembly including two conductive members, each said conductive member having width greater than the space between adjacent said blades, said conductive members superposed on opposite sides of the median plane of said blades to bridge adjacent said blades to provide parallel conductive paths between two adjacent said blades, whereby electromagnetic forces resulting from parallel current flow through said conductive members aid in holding said conductive members firmly pressed to said blades, a shaft having its axis of rotation disposed perpendicular to the median plane of said blades at the center of the arc of said blades, said shaft having a member extending laterally of its axis, driving means comprising the sole means connecting said two conductive members with said lateral member whereby said shaft rotates and moves said conductive members, said connecting means comprising a first pin and a second pin fixedly attached to a first of said members extending therefrom normal to the median plane of said blades and projecting loosely through the other two of said members with clearance whereby upon rotation of said shaft said lateral member rotates said conductive members through coacting driving and driven surfaces of said pins and said other two members and each said conductive member is free to rock with respect to the other said members, said pins being spaced apart to con-

stitute means coacting between said members to prevent said conductive members from turning with respect to said lateral member and to cause said conductive members to be moved with said lateral member, and resilient means coacting with said members to keep said other two members in cooperative engagement with said pins.

4. A switch comprising a plurality of conductive blades uniformly spaced on an arc, a shaft having its axis of rotation perpendicular to the median plane of said blades at the center of said arc, a laterally extending arm fast on said shaft, a rotary contact assembly moved by said shaft, said assembly including first and second conductive members each of which is wide enough to bridge two adjacent said blades, said members being superposed on opposite sides of the median plane of said blades to provide parallel paths of current through said conductive members between adjacent said blades, two pairs of driving pins carried by said arm extending generally parallel to said shaft with the pins of each said pair of pins being spaced apart, one of said pair of pins extending from a first face of said arm projecting loosely into said first conductive member and the other of said pair of pins extending from the opposite face of said arm projecting loosely into said second conductive member whereby upon rotation of said shaft said conductive members are moved by said pins abutting surfaces of said conductive members constituting the sole means connecting said conductive members to said shaft, and resilient means to firmly hold said conductive members in position to be abutted by said driving pins and to press said conductive members on said blades.

5. A switch comprising a plurality of conductive blades uniformly spaced on an arc, a shaft having its axis of rotation perpendicular to the median plane of said blades at the center of said arc, a laterally extending arm fast on said shaft, a rotary contact assembly moved by said shaft, said assembly including a pair of conductive members each of which is wide enough to bridge two adjacent said blades, said members superposed on opposite sides of the median plane of said blades, connecting means between said blades and said shaft including two pairs of driving pins carried by said arm extending generally parallel to said shaft with said pairs of driving pins extending from opposite faces of said arm, each of said members having driven surfaces spaced apart and loosely engaged by said driving pins, rotation of said shaft causing said driving pins to abut said driven surfaces constituting the sole means connecting said members with said shaft, whereby said members are rotated about the axis of said shaft, each of said members having three protuberances engaging two adjacent said blades at two points and said arm at one point to provide three point support for each of said members, and resilient means to firmly hold said members in position with said driven surfaces disposed to be abutted by said pins and to press said members against said blades.

6. A switch comprising a plurality of conductive blades uniformly spaced on an arc, a shaft having its axis of rotation perpendicular to the median plane of said blades at the center of said arc and having an arm extending laterally of its axis, a rotary contact assembly movable by said shaft, said assembly including a pair of conductive members each of which is wide enough to bridge two adjacent said blades, said conduc-

tive members superposed on opposite sides of the median plane of said blades, means between said members and said laterally extending arms comprising two pair of driving pins carried by said arm extending generally parallel to said shaft, said pairs of driving pins extending from different faces of said arm, each of said members having spaced driven surfaces and three protuberances, said driving pins in loose engagement with said driven surfaces being abutted therewith upon rotation of said shaft constituting the sole means connecting said members and said shaft and providing for each of said members to have independent rocking movement with respect to said pins, resilient means to firmly hold said members in position that said driven surfaces are abutted by said pins when said shaft is rotated and to press two of said three protuberances of each said member against two adjacent said blades and the third of said three protuberances of each said member against said arm, and means to prevent the adjacent faces of said members coming together when said members are moved from engagement with any said blade.

7. A switch comprising a plurality of conductive blades uniformly spaced on an arc, a shaft having its axis of rotation perpendicular to the median plane of said blades at the center of the arm of said blades and having an arm extending laterally of its axis, a moving contact assembly including two conductive members, said members superposed on opposite sides of the median plane of said blades, a driving pin carried by said arm, each of said members having a driven surface defining a hole loosely receiving said driving pin to be abutted by said driving pin upon rotation of said shaft constituting the sole means connecting said members to said shaft and providing for independent rocking movement of said members with respect to each other and with respect to said shaft, each of said members of a width greater than the space between adjacent said blades to bridge adjacent said blades and provide parallel conductive paths between any two adjacent said blades, each of said members having three point support and being independently movable with respect to any of the three points of support, two of said three points being on said blades, and biasing means including a spring acting on said members within said three points of support.

8. A switch comprising a plurality of conductive blades uniformly spaced on an arc, a shaft with its axis of rotation perpendicular to the median plane of said blades at the center of said arc having an arm extending laterally of its axis, and a rotary contact assembly movable by said shaft, said assembly including a pair of conductive members, driving surfaces carried by said arm independent of said members, driven surfaces carried by said members independent of said driving surfaces, said driving and driven surfaces disposed to be abutted against each other upon rotation of said shaft constituting the sole means connecting said members and said arm, and biasing means urging said members toward each other to position said members that said driving and driven surfaces abut upon rotation of said shaft, said members being substantially identical and each having three protuberances triangularly spaced with two of said protuberances being spheroidal contact buttons on said arc, the distance between said contact buttons of each of said members being greater than the distance between adjacent of said

blades, said members being superposed on opposite sides of the median plane of said blades, said biasing means acting within said triangularly spaced protuberances to cause two of said contact buttons of each of said members to make first point contact with adjacent of said blades providing parallel current paths through said members between any two adjacent said blades and to cause the third of said protuberances of each of said members to make firm point contact with said arm between the arc of said blades and the axis of said shaft to provide three point support for each of said members at its said three protuberances.

9. A switch comprising a plurality of conductive blades uniformly spaced on an arc, a movable contact assembly including a pair of conductive members, a shaft with its axis of rotation perpendicular to the median plane of said blades at the center of said arc having an arm extending laterally of its axis, means for connecting said members to said arm for moving said members across said blades by rotation of said members about the axis of said shaft, said means including a pair of spaced driving elements carried by said arm independent of said members, driven surfaces carried by each of said members independent of said driving elements, said driving elements disposed to abut said driven surfaces upon rotation of said shaft constituting by such abutment the sole means connecting said members to said arm whereby said shaft effects rotation of said members and whereby said members have independent rocking relation with respect to said arm, said members being substantially identical and each having three protuberances triangularly spaced with two of said three protuberances being spheroidal contact buttons on said arc spaced apart a distance greater than the spacing between adjacent of said blades to engage adjacent said blades, the third of said protuberances being in contact with said arm, said members being superposed on opposite sides of the median plane of said blades providing parallel current paths between adjacent of said blades, said assembly including a link connecting said members and retaining said members superposed, and biasing means acting on said members within the triangle defined by said protuberances to press said protuberances of each of said members on said blades and on said arm and to hold said members in position that said driving elements abut said driven surfaces upon rotation of said shaft.

10. A switch comprising a plurality of blades, an insulating panel, said blades fastened to said panel and circumferentially spaced from each other on an arc, a shaft movable with respect to said blades with its axis of rotation perpendicular to the median plane of said blades at the center of said arc, said shaft having a lateral member fast thereon, a rotary contact assembly comprising a first conductive member, a second conductive member, connecting means and biasing means, said connecting means including driving surfaces carried by said lateral member independent of said conductive members, a driven surface carried by said first conductive member independent of said lateral member, a driven surface carried by said second conductive member independent of said lateral member, said conductive members being axially spaced along said shaft and extending laterally of said shaft with said first conductive member superposed over said second conductive member, a first face of said

first conductive member parallel to a first face of said lateral member, a first face of said second conductive member parallel to the opposite face of said lateral member, said driving surfaces disposed adjacent said driven surfaces whereby rotation of said shaft causes said driving surfaces to abut said driven surfaces constituting the sole means connecting said rigid members to said lateral member to effect rotation of said conductive members about the axis of said shaft, the median plane of said blades disposed between said conductive members with the opposite contact surfaces of each of said blades being substantially normal to said axis, each of said conductive members having three protuberances triangularly positioned thereon, each of said protuberances being substantially spherical, two of said protuberances on each of said conductive members being contact buttons disposed on the arc of said blades and spaced apart to bridge adjacent said blades and making substantially point contact with one of said surfaces of said blades, the third of said protuberances of each of said conductive members being in contact with said lateral member intermediate said arc and said shaft whereby said three protuberances of each of said conductive members provide three point support for said respective conductive member, biasing means including a link extending through said conductive members parallel to the axis of said shaft keeping said conductive members superposed, abutment means to limit the distances between said conductive members to a predetermined maximum value and to keep said driving and driven surfaces in position to be abutted with each other upon rotation of said shaft, means to limit the distance between said conductive members to a predetermined minimum value, and resilient means acting on said conductive members within the triangle defined by said protuberances to force said protuberances of each said conductive member into firm contact with said blades and said lateral member.

11. A switch comprising a plurality of blades, an insulating panel, said blades fastened to said panel and substantially uniformly spaced on an arc, a shaft movable with respect to said blades having its axis of rotation perpendicular to the median plane of said blades at the center of said arc and having a member extending laterally of its axis, a rotary contact assembly comprising two rigid conductive members axially spaced apart along said shaft with said members disposed on opposite sides of said lateral member and on opposite sides of the median plane of said blades, connecting means including driving surfaces carried by said lateral member independent of said rigid members, a driven surface carried by a first of said rigid members independent of said driving surfaces, a driven surface carried by the second of said rigid members independent of said driving surfaces, said driving surfaces disposed to abut said driven surfaces upon rotation of said shaft constituting the sole means connecting said rigid members to said lateral member to effect rotation of said rigid members about said axis, each of said rigid members having three spherical protuberances triangularly spaced thereon, two of said protuberances on each of said rigid members being contact buttons disposed on said arc and spaced apart circumferentially to bridge adjacent of said blades and making substantially point contact with a contact surface of said blades, the third of said protuberances of each of said rigid members making substantially point

contact with said lateral member intermediate said arc of said shaft, and biasing means including a link, a spring, retaining means and abutment means, said link extending through said members parallel to the axis of said shaft, said retaining means detachably connected to said link, said abutment means cooperating with said link and said rigid members to limit the distance between said rigid members to a predetermined value, said retaining means holding said spring against one of said rigid members and cooperating with said abutment means to force said protuberances of said rigid members into firm contact with said blades and said lateral members and to keep said driving and driven surfaces in position to be abutted with each other.

12. A switch comprising a plurality of blades, an insulating panel, said blades fastened to said panel and substantially uniformly spaced on an arc, a shaft movable with respect to said blades with said shaft having its axis of rotation perpendicular to the median plane of said blades at the center of said arc, said shaft having a member extending laterally of its axis, a moving contact assembly comprising two rigid conductive members, said conductive members being spaced axially along said shaft on opposite sides of said lateral member and on opposite sides of the median plane of said blades, connecting means including driving surfaces carried by one of said three members independent of the other two said members, and driven surfaces carried by each of the other two said members independent of said driving surfaces, said driving surfaces disposed adjacent said driven surface to abut said driven surfaces upon rotation of said shaft constituting the sole means connecting said conductive members to said lateral member to effect rotation of said conductive members about the axis of said shaft, each of said conductive members having three protuberances triangularly positioned thereon with two of said three protuberances being spherical contact buttons on said arc spaced apart with said two buttons of each of said conductive members contacting adjacent of said blades whereby each of said conductive members bridges two adjacent of said blades, the third protuberance of each of said conductive members contacting said lateral member intermediate said arc and said axis, said three protuberances of each of said conductive members providing three point support for said conductive members, and biasing means acting on each of said conductive members within the triangle defined by said protuberances to force said protuberances against said blades and against said lateral member to keep said driving and driven surfaces in position to abut each other upon rotation of said shaft.

13. A switch comprising a plurality of blades, an insulating panel, said blades fastened to said panel and substantially uniformly spaced on an arc, a shaft movable with respect to said blades, said shaft having its axis of rotation perpendicular to the median plane of said blades at the center of said arc and having a member extending laterally thereof, a rotary contact assembly comprising two conductive members spaced apart axially along said shaft and extending laterally of the axis of said shaft with one of said conductive members superposed over the other of said conductive members, said conductive members disposed on opposite sides of the lateral member and on opposite sides of the median plane of said blades, the adjacent faces of each

13

said conductive member having three spherical protuberances triangularly spaced thereon with two of said protuberances being contact buttons disposed on said arc making substantially point contact with a surface of said blades, and spaced 5 apart to bridge adjacent of said blades and the third said protuberance making point contact with said lateral member intermediate said arc and said axis, biasing means disposed within the triangle of said protuberances and including a link and 10 a spring, said link carried by one of said members independent of the other two said members constituting driving surfaces extending through the other two said members with clearance, the wall surfaces of each said other two members 15 through which said link extends constituting driven surfaces independent of said driving surfaces, said driving surfaces being abutted said driven surfaces upon rotation of said shaft constituting the sole means connecting said con- 20 ductive members to said lateral member, said

14

link carrying lateral abutments on opposite sides of said conductive members, said spring abutting one of said conductive members and one of said abutments and cooperating with the other of said abutments to force said protuberances of said conductive members into firm contact with said blades and said lateral member, and means for preventing said conductive members from rotating with respect to said lateral member.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
2,491,696	Venditty	Dec. 20, 1949
2,577,225	Barry	Dec. 4, 1951

FOREIGN PATENTS

Number	Country	Date
394,532	Great Britain	June 29, 1933
562,938	Great Britain	July 21, 1944