Nov. 8, 1955 J. C. SEBRING ET AL 2,723,319

ROTARY LIMIT SWITCH

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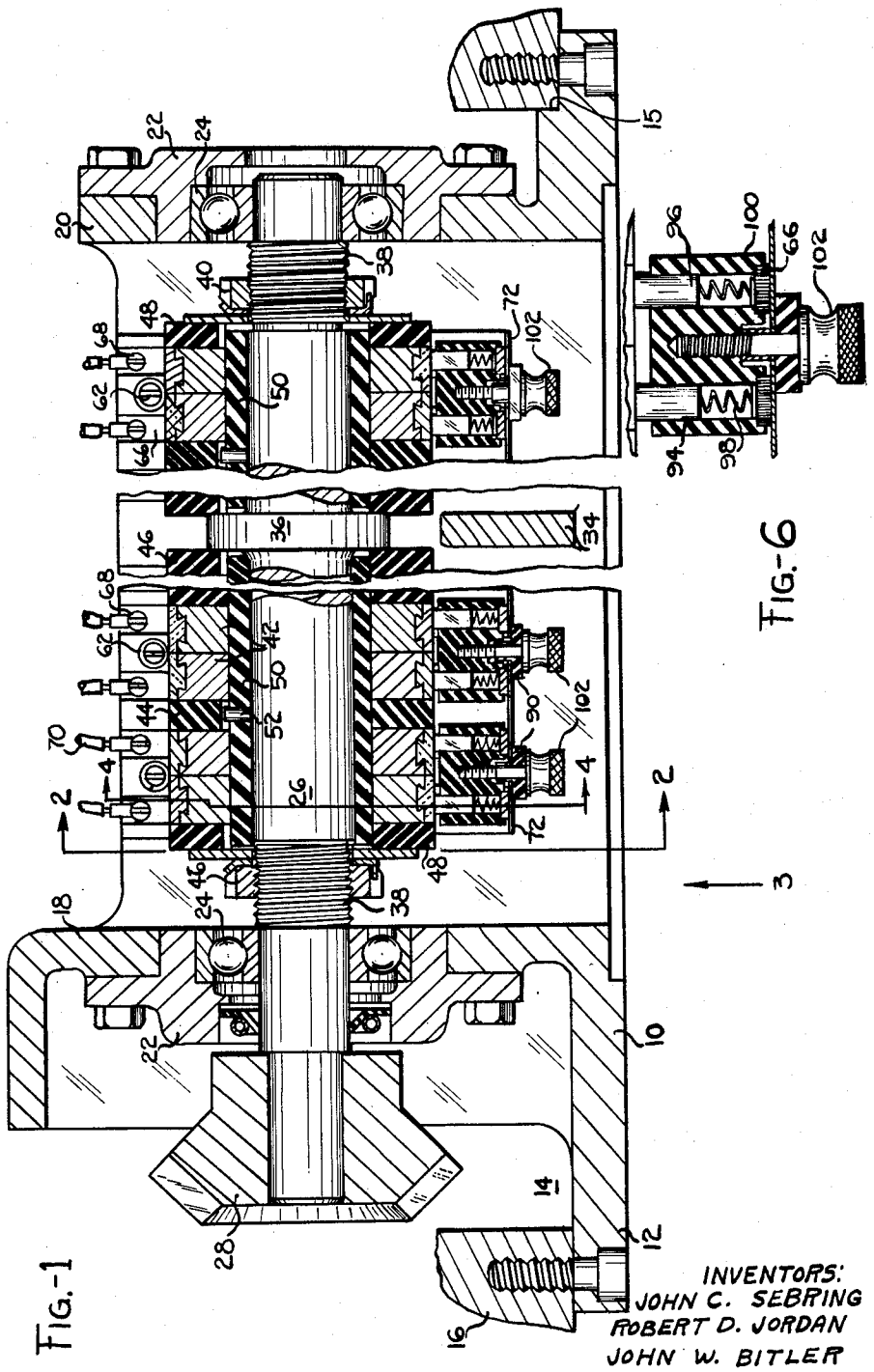


FIG. 6

FIG. 1

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ROTARY LIMIT SWITCH

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FIG.-2

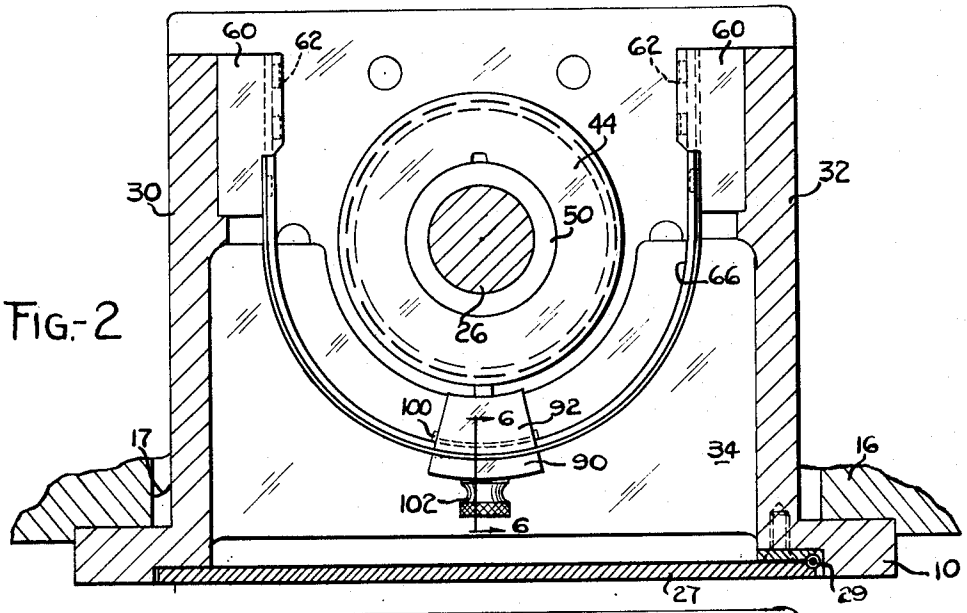
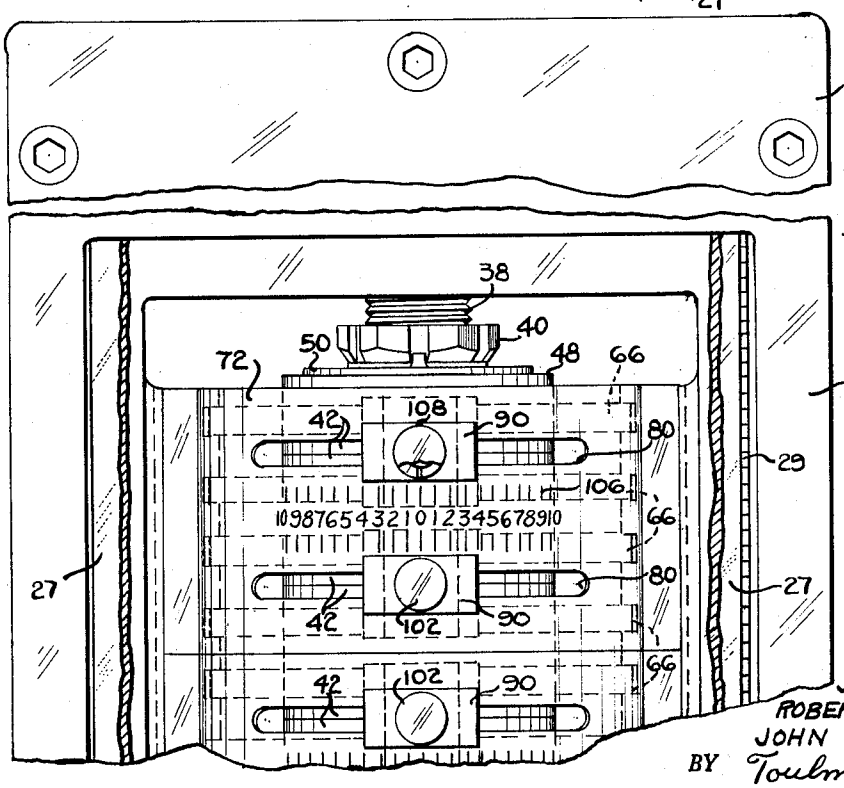


FIG.-3



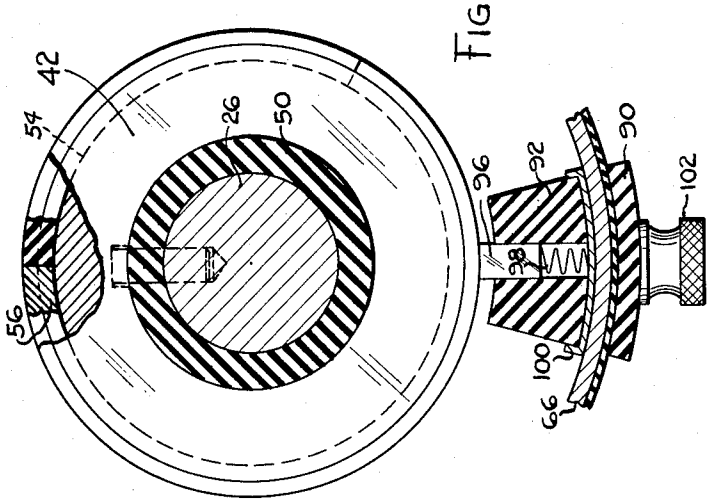
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ROTARY LIMIT SWITCH

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FIG-4



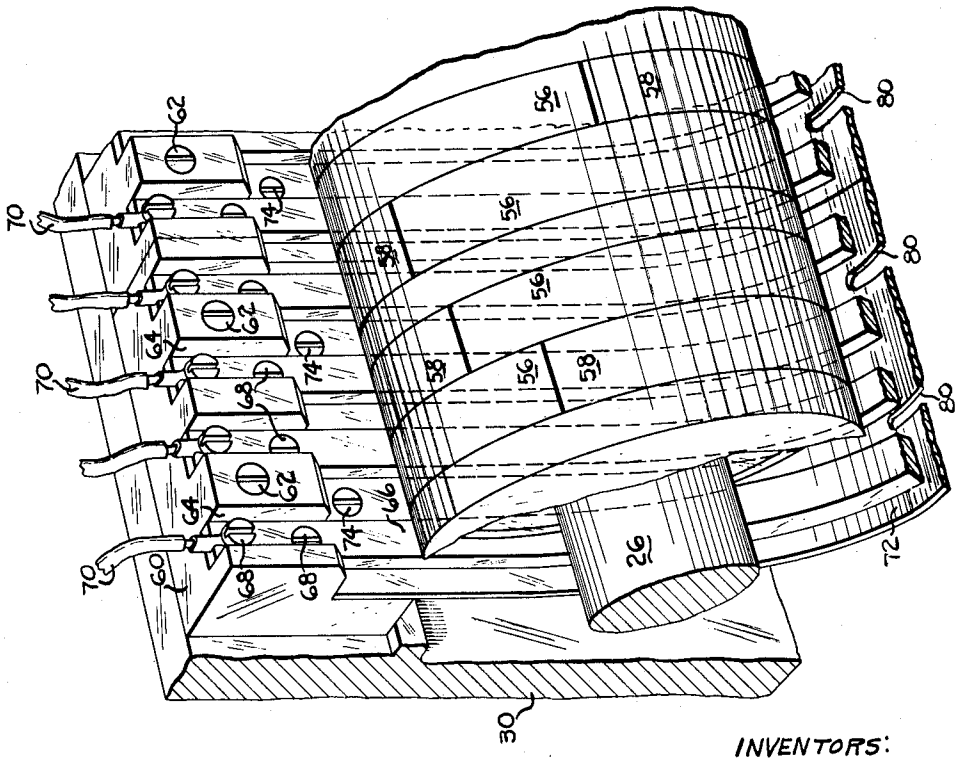


FIG-5

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2,723,319

ROTARY LIMIT SWITCH

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Application September 11, 1953, Serial No. 379,576

18 Claims. (Cl. 200—25)

This invention relates to switches, and particularly to rotary limit switches of the general type illustrated in the Bitler application Serial Number 331,836, filed January 19, 1953, and in the issued Bitler Patent No. 2,520,709, issued August 29, 1950, both assigned to the same assignee as the instant application.

The rotary switches of the above-identified issued patent and pending application, as well as the one of the instant application, are provided for the purpose of making and breaking electrical circuits repetitively and at a high rate of speed, and with the respective make and break periods being adjustable in duration.

The present invention is concerned with a greatly improved rotary switch arrangement for accomplishing the control of electric circuits as referred to.

A particular object of the present invention is to eliminate from the rotary limit switch any loose wires or flexible leads, thereby making it possible to maintain the switch in service for an appreciably longer length of time than was previously possible, and eleminating the hazards of broken circuits and shorts.

Another particular object is the provision of adjusting means that can be operated while the switch is in operation and effecting a wide range of adjustment of the switch.

A still further object is the provision of a construction such that the parts of the rotary limit switch are readily accessible for service and adjustment.

A particular object in connection with the foregoing object relating to service and adjustment of the switch is the provision of an arrangement whereby the brushes of the switch that bear on the rotary elements of the switch can readily be replaced or serviced.

Another particular object is the provision of a construction such that the rotary segments can readily be adjusted individually of each other without the adjustment of any one segment or set of segments affecting another set of segments.

These and other objects and advantages will become more apparent upon reference to the following description taken in connection with the accompanying drawings, in which:

Figure 1 is a longitudinal sectional view through a switch constructed according to my invention, with portions thereof broken away to permit the switch to be drawn at large scale;

Figure 2 is a cross-sectional view, indicated by line 2—2 on Figure 1;

Figure 3 is a view looking in the direction of the arrow 3 in Figure 1;

Figure 4 is a fragmentary sectional view taken on line 4—4 of Figure 1;

Figure 5 is a fragmentary perspective view showing the construction of the switch; and

Figure 6 is a sectional view, indicated by line 6—6 on Figure 2, showing the construction of one of the brush holders forming a part of the switch.

Referring to the drawings somewhat more in detail,

the switch comprises a fame 10 having projecting flanges on the base, as at 12, by means of which it can be bolted into an aperture 14 in a machine frame 16. Finished bosses at 15 in Figure 1 and 17 in Figure 2 serve to locate the switch frame within the aperture. The switch is illustrated in Figure 1 as lying horizontally, but it will be evident as the description of the construction of the switch proceeds that it could be disposed at any desired angle, preferably vertically.

The frame 10 of the switch comprises spaced end walls 18 and 20, each of which is apertured for receiving a bearing block 22, and within each of which blocks is mounted an antifriction bearing 24. Bearings 24 are mounted on a shaft 26 and the end of the shaft extending through end wall 18 carries a bevel drive pinion 28 adapted for meshing with any suitable bevel gear driven by the machine which the switch controls. Other drive means, such as a chain and sprocket could also be employed.

As will be seen in Figure 2, frame 10 of the switch comprises, in addition to the end walls 18 and 20, the side walls 30 and 32, so that the end and side walls form a box-like frame, open top and bottom, and surrounding shaft 26. The bottom, or outer opening, may be provided with a door 27 (Figure 2) hinged at 29, if desired.

The actual switch construction is considerably longer than is illustrated in Figure 1, and, accordingly, there is preferably provided midway between the ends of the frame and extending between side walls 30 and 32 a transverse strengthening rib 34.

Shaft 26 in the region of rib 34 comprises an annular collar 36, either formed on the shaft or made rigid therewith by any suitable means. The opposite ends of shaft 26 immediately inwardly of walls 18 and 20 are threaded, as at 38, for receiving clamp nuts 40. Clamped between each clamp nut 40 and central collar 36 on shaft 26 are a plurality of sets of rotary segments 42, with each set being separated from the adjacent sets by intervening insulating segments 44. An insulating segment 46 is provided between central collar 36 of shaft 26 and the adjacent set of segments on each side thereof, while insulating segments 48 are provided between the outer end sets of segments on shaft 26 and the washer that is pressed thereagainst between clamp nuts 40.

Each end of shaft 26 is provided with an insulating sleeve 50 on which the segments are mounted, thereby to provide substantially continuous electrical insulation between shaft 26 and the segments to prevent any possibility of the segments shorting out through the shaft.

Each of the insulating segments 44 has a notch therein, and fixed in shaft 26 in alignment with each of the intervening segments and projecting through the adjacent sleeve 50 into said notch is a pin 52. Pin 52 insures that the insulating segments 44 will rotate with shaft 26, and likewise provides that adjustment of the set of segments on either side of the insulating segment will not affect adjustment of the set of segments on the opposite side.

Each of the segments 42 is constructed of steel or a like material and has a generally dovetail groove extending about the periphery thereof. This groove is availed of for mounting about the periphery of the segment conductive and nonconductive sections arranged in end-to-end abutting relation. The conductive section is advantageously formed of copper or a like material, while the nonconductive section may be formed of mica or a plastic material.

Figure 4 illustrates one typical arrangement of one of segments 42, and wherein the dovetail groove referred to is identified by reference numeral 54, and mounted in the dovetail groove is a conductive copper section 56 and a nonconductive insulating section 58. In Figure 4 the

insulating section is approximately 120° in extent, and the conductive section therefore extends over approximately 240°

The described arrangement of segments on shaft **26** is availed of for controlling electric circuits by effecting electrical connection with the segments by the arrangement illustrated in Figures 1, 2, 4, and 5. As will best be seen in Figures 2 and 5, there is arranged along the inside of each of the side walls **30** and **32** at the tops thereof the insulating blocks **60** which are retained in position by the screws **62**.

Each of the blocks **60** spans four segments, or two sets of segments, along shaft **26** and is provided with a vertical groove **64** in alignment with each of the said segments. Extending between the grooves **64** and oppositely located of the blocks **60**, and thus extending in planes parallel with the planes of the respective segments, are the relatively heavy conductive buss bars **66**, preferably formed of copper. Buss bars **66** are held in place in their respective groove by the screws **68**, the upper one of which at one side of the switch may advantageously be employed for clamping the end of an electric lead **70** in conductive relation with the respective buss bar. For each set of insulating blocks **60**, that is, for each set of four buss bars, corresponding to two pairs of two sets of segments on shaft **26**, there is a flexible insulating cover sheet **72** provided, passing about the outside surfaces of buss bars **66** and having its end portions secured to the insulating blocks **60** on the opposite sides of the switch by the screws **74**. The arrangement of this cover sheet **72** will best be seen in Figures 2, 3, and 5.

As a material suitable for the cover sheet **72**, I have found a number of plastic materials commercially available to be satisfactory.

As will be seen in Figure 3, the cover sheet, or buss bar guard, is provided with slots **80**, one slot for each set of segments, and each slot being in the plane of abutment of segments of each set. Each slot **80** slidably receives an arcuate insulating block **90** on the outside of buss bar guard **72**, and located inside the buss bar guard and buss bars is a second insulating block **92**. The second insulating block, as will best be seen in Figure 6, is provided with two square bores **94**, each receiving a carbon brush **96**, urged toward the periphery of the adjacent segment **42** by a spring **98**. Each spring **98** is held in position by a thin metallic strip **100** on which the spring bears, and which metallic strip **100** is pressed against the adjacent buss bar **66** by compression spring **98**. In this manner good electrical contact is maintained between each buss bar and the associated brush **96** and segment **42**.

A knurled screw **102** extends through block **90** into threaded engagement with block **92**, and in this manner the blocks can be clamped in any desired position of adjustment in the pertaining slot **80**.

Each of the slots **80** permits adjustment of the pertaining brush holders therein over an arc of substantially 90°, and to facilitate in the correct positioning of the brush holders in the slots, the space between the pairs of slots **80** in each of the buss bar guards **72** is provided with numbered calibrations **106**, and each of blocks **90** is provided with a transversely extending saw slot **108** for registration with the calibrations **106**.

In utilizing the switch according to this invention, one or more sets of segments **42** can be included in an electric circuit by availing of the leads **70**, one of which leads from each of the buss bars **66**. Assuming, for example, that the set of segments at the left-hand side of Figure 1 were to be placed in a circuit to control make and break periods thereof, the two leads **70** leading from the two buss bars **66** associated with the left-hand pair of segments **42** would be connected into the circuit, thus placing the set of segments in serial arrangement in the circuit.

The period during which the circuit including the segments was to be made could then be adjusted by loosening left-hand clamp nut **40** and adjusting the individual segments of the segment set circumferentially relative to each other, until the peripheral extent of the conductive sections, commencing at the one end of one of the conductive sections and terminating at the other end of the other thereof, the sections being, of course, in overlapping relation, produced the proper length of make period. Having established the make and break periods of the electric circuit in this manner, these periods, without any change in the duration thereof, could be adjusted relative to the operating cycle of the machine by adjustment of the brush holder pertaining to the set of segments in its slot **80**. This would alter the precise time of making and breaking the circuit with respect to the cycle of the machine, but would not change the duration of the make and break periods.

It will be evident that the particular lengths of the conductive sections on the segments would be important in determining the maximum and minimum limits of adjustment of which the segment set was capable.

If, now, it would be desired to provide a circuit with means for making and breaking the circuit according to adjustable periods, while also providing means for varying the time of occurrence of the periods in the machine cycle, two sets of segments would be employed, for example, the two left-hand sets of segments in Figure 1, by conducting the extreme left-hand buss bar to one terminal of the circuit to be controlled, and the extreme right-hand buss bar to the other terminal of the circuit, and interconnecting the two intermediate buss bars.

With this arrangement, a general setting of the make and break period could be accomplished by angular adjustment of the individual segments of each set relative to each other, and precise adjustments of the make and break periods and of the instants of making and breaking the circuit relative to the machine cycle by adjustment of the two brush holders pertaining to the two sets of segments.

By the described arrangement a complete adjustment of the make and break periods from zero to 360° of rotation of shaft **26** can readily be effected and adjustment of the brushes by moving the brush holders can be effected at any time without stopping the machine or switch, and without any danger of shock.

The switch construction is such that all parts are readily accessible for servicing, replacement, or repair, and all flexible wires and leads within the switch structure are entirely eliminated.

It will be understood that this invention is susceptible to modification in order to adapt it to different usages and conditions, and, accordingly, it is desired to comprehend such modifications within this invention as may fall within the scope of the appended claims.

We claim:

1. A rotary switch comprising; a frame, a shaft rotatable in the frame, segments mounted on the shaft each having a portion of its periphery electrically conductive, arcuate buss bars arranged coaxially with said segments, brush holders slidable along the buss bars, and brushes in the brush holders bearing on the peripheries of the segments and in electrical contact with said buss bars.

2. A rotary switch comprising; a frame, a shaft rotatable in the frame, segments on the shaft electrically insulated therefrom, each having a portion of its periphery electrically conductive, arcuate buss bars carried by the frame and electrically insulated therefrom, said buss bars extending about said segments concentrically therewith, brush holders slidable along the buss bars, and brushes in the brush holders bearing on the peripheries of the segments and also in electrical contact with said buss bars.

3. A rotary switch comprising; a frame, a shaft rotatably mounted in the frame, segment sets mounted on the shaft electrically insulated therefrom and from each

other, each segment set comprising at least two segments each having a portion of its periphery electrically conductive, arcuate buss bars carried by said frame and electrically insulated therefrom, said bars extending about said segments concentrically therewith, brush holders slidable along said buss bars and brushes in said brush holders bearing on the peripheries of said segments and also in electrical contact with said buss bars.

4. A rotary switch comprising; a frame, a shaft rotatably supported in the frame, a plurality of segment sets mounted on said shaft and electrically insulated therefrom, insulating disks on the shaft between the segment sets, each segment set comprising at least two segments with each segment having a portion of its periphery electrically conductive and the other portion thereof electrically nonconductive, arcuate buss bars carried by the frame and electrically insulated therefrom, each buss bar being in the plane of one of said segments and extending about the said segment concentrically therewith and spaced radially therefrom, a brush holder for each segment set slidable along the buss bars pertaining to the said set, and a brush in said holder for each segment bearing on the periphery of the said segment and in electrical contact with the buss bar pertaining to the said segment.

5. A rotary switch comprising; a frame, a shaft rotatably supported in the frame, a plurality of segment sets mounted on said shaft and electrically insulated therefrom, insulating disks on the shaft between the segment sets, each segment set comprising at least two segments with each segment having a portion of its periphery electrically conductive and the other portion thereof electrically non-conductive, arcuate buss bars carried by the frame and electrically insulated therefrom, each buss bar being in the plane of one of said segments and extending about the said segment concentrically therewith and spaced radially therefrom, a brush holder for each segment set slidable along the buss bars pertaining to the said set, and a brush in said holder for each segment bearing on the periphery of the said segment and in electrical contact with the buss bar pertaining to the said segment, each brush holder comprising means for clamping it in adjusted position along its supporting buss bars.

6. A rotary switch comprising a frame, a shaft rotatably supported in the frame, an enlarged portion intermediate the ends of said shaft, insulating sleeves on said shaft abutting the opposite sides of said enlarged central portion, a plurality of segment sets mounted on each said sleeve, each said set comprising at least two segments and each segment having a portion of its periphery electrically conductive and the other portion nonconductive, insulating disks on said sleeves between adjacent segment sets, a buss bar carried by the frame and electrically insulated therefrom in the plane of each of said segments, said bars extending about the said segments concentrically therewith but radially spaced therefrom, a brush holder for each segment set slidable on the buss bars pertaining to the said segment set, brushes in said brush holders bearing on said segments and in electrical contact with said buss bars, means for clamping said brush holders in their adjusted positions along said bars, and releasable means clamping said segment sets and intervening insulating disks fixedly to said shaft.

7. A rotary switch comprising; a frame, a shaft rotatably mounted in the frame, a plurality of segment sets mounted in the shaft electrically insulated from the shaft and from each other, each segment set comprising at least two segments in face-to-face relation and each segment having a portion of its periphery electrically conductive and the other portion of its periphery electrically nonconductive, insulating blocks mounted in the frame on opposite sides of said shaft, arcuate buss bars extending between and connected to said blocks arranged concentrically with said segments and there being one buss bar in the plane of each segment, a brush holder for each segment set slidable along the buss bars pertaining to the said set, a brush in said brush holder for each segment of the set bearing on the periphery of the segment and in electrical contact with the buss bar pertaining to the said segment, an arcuate cover sheet extending between said insulating blocks and over said buss bars, and means accessible from outside said cover sheet for moving said brush holders along said buss bars and for clamping the brush holders to said buss bars.

8. A rotary switch comprising; a frame, a shaft rotatably mounted in the frame, a plurality of segment sets mounted on the shaft electrically insulated from the shaft and from each other, each segment set comprising at least two segments in face-to-face relation and each segment having a portion of its periphery electrically conductive and the other portion of its periphery electrically nonconductive, insulating blocks mounted in the frame on opposite sides of said shaft, arcuate buss bars extending between and connected to said blocks arranged concentrically with said segments and there being one bus bar in the plane of each segment, a brush holder for each segment set slidable along the buss bars pertaining to said set, a brush in said brush holder for each segment of the set bearing on the periphery of the segment and in electrical contact with the buss bar pertaining to the said segment, an arcuate cover sheet extending between said insulating blocks and over said buss bars, said cover sheet being slotted between said buss bars, and means extending through said slots into engagement with said brush holders for adjusting said brush holders along said buss bars and for clamping the brush holders to said buss bars.

9. A rotary switch comprising; a frame, a shaft rotatably mounted in the frame, a plurality of segment sets mounted on the shaft electrically insulated from the shaft and from each other, each segment set comprising at least two segments in face-to-face relation and each segment having a portion of its periphery electrically conductive and the other portion of its periphery electrically nonconductive, insulating blocks mounted in the frame on opposite sides of said shaft, arcuate buss bars extending between and connected to said blocks arranged concentrically with said segments and there being one buss bar in the plane of each segment, a brush holder for each segment set slidable along the buss bars pertaining to the said set, a brush in said brush holder for each segment of the set bearing on the periphery of the segment and in electrical contact with the buss bar pertaining to the said segment, an arcuate cover sheet extending between said insulating blocks and over said buss bars, said cover sheet being slotted between said buss bars, and means extending through said slots into engagement with said brush holders for adjusting said brush holders along said buss bars and for clamping the brush holders to said buss bars, said last-mentioned means and said cover sheet having cooperating indicia for indicating the exact position of said brush holders along their supporting buss bars.

10. A rotary switch comprising; a generally rectangular frame having end walls and side walls and open top and bottom, a shaft extending between and journaled in said side end walls, said shaft having an enlargement thereon intermediate said end walls and being threaded immediately inwardly of said end walls, a sleeve of electrical insulating material on each end of the shaft extending from the threaded portion thereof to the said enlarged portion thereof, a plurality of sets of metallic segments mounted on each of said sleeves, insulating disks between said segment sets and between the innermost segment sets and the enlarged portion of the shaft and between the outermost segment sets on the threaded portions of said shaft, clamp nuts on the threaded portions of said shaft for releasably clamping the segment sets in position on the shaft, a pin in the shaft in the plane of each insu-

lating disk located between adjacent segment sets, each pin extending through the adjacent sleeve and engaging the insulating disk, whereby the said segment sets can be adjusted without affecting the adjustment of adjacent segment sets, and rigid buss bar means mounted in said frame concentrically with said segments for effecting electrical connection therewith.

11. In a rotary switch of the nature described in which a plurality of segments are carried on a rotatable shaft with each segment having a portion of its periphery electrically conductive and the other portion thereof electrically nonconductive, and brush means are provided engaging the periphery of said segments, the improvement which comprises fixedly mounting rigid buss bars concentrically with said segments, and slidably supporting a brush holder on said buss bars carrying said brushes and effecting electrical connection between said brushes and said buss bars whereby electrical connections to said switch can be made to the buss bars, thereby eliminating flexible leads to said brushes.

12. In a rotary switch; a circular segment having conductive and nonconductive peripheral sections, a substantially rigid buss bar mounted concentrically with said segment, a block of insulating material slidable along the buss bar between the buss bar and the segment, a bore through said block radial of the segment, a brush in said bore, and a spring bearing between the buss bar and the brush to hold the brush against the segment and to maintain the brush in electrical contact with the buss bar.

13. In a rotary switch; a pair of circular segments side-by-side each having an angular portion of its periphery electrically conductive and the remainder of its periphery electrically nonconductive, a substantially rigid buss bar in the plane of each segment, said buss bars being radially spaced from the segments and concentric therewith, a block of electrical insulating material on the segment sides of said buss bars and slidably guided thereon for movement angularly about said segments, a bore in said block in the plane of each segment and the pertaining buss bar radial to the segments, a brush in each bore, and a spring electrically connecting each brush with the adjacent buss bar and urging the brush into engagement with the periphery of the pertaining segment.

14. In a rotary switch; a pair of circular segments side-by-side each having an angular portion of its periphery electrically conductive and the remainder of its periphery electrically nonconductive, a substantially rigid buss bar in the plane of each segment, said buss bars being radially spaced from the segments and concentric therewith, a block of electrical insulating material on the segment sides of said buss bars and slidably guided thereon for movement angularly about said segments, a bore in said block in the plane of each segment and the pertaining buss bar radial to the segments, a brush in each bore, and a spring electrically connecting each brush with the adjacent buss bar and urging the brush into engagement with the periphery of the pertaining segment, a guard sheet of electrical insulating material covering said buss bars on the side opposite said block and slotted between said buss bars, and means engaging said block through said slot for adjusting the block along the buss bars and for clamping it thereto.

15. In a rotary switch; a pair of circular segments side-by-side each having an angular portion of its periphery electrically conductive and the remainder of its periphery electrically nonconductive, a substantially rigid buss bar in the plane of each segment, said buss bars being radially spaced from the segments and concentric therewith, a block of electrical insulating material on the segment sides

of said buss bars and slidably guided thereon for movement angularly about said segments, a bore in said block in the plane of each segment and the pertaining buss bar radial to the segments, a brush in each bore, and a spring electrically connecting each brush with the adjacent buss bar and urging the brush into engagement with the periphery of the pertaining segment, there being a metallic shoe loosely carried by the said block in the plane of each buss bar located between the buss bar and the said spring.

16. In a rotary switch; a pair of circular segments side-by-side each having an angular portion of its periphery electrically conductive and the remainder of its pheriphery electrically nonconductive, a substantially rigid buss bar in the plane of each segment, said buss bars being radially spaced from the segments and concentric therewith, a block of electrical insulating material on the segment sides of said buss bars and slidably guided thereon for movement angularly about said segments, a bore in said block in the plane of each segment and the pertaining buss bar radial to the segments, a brush in each bore, a spring electrically connecting each brush with the adjacent buss bar and urging the brush into engagement with the periphery of the pertaining segment, a guard sheet of electrical insulating material covering said buss bars on the side opopsite said block and slotted between said buss bars, a clamp member outside said guard sheet aligned with said block, and a clamp screw extending through said member and slot into screw-threaded engagement with the said block.

17. In a rotary switch; a pair of circular segments side-by-side each having an angular portion of its periphery electrically conductive and the remainder of its periphery electrically nonconductive, a substantially rigid buss bar in the plane of each segment, said buss bars being radially spaced from the segments and concentric therewith, a block of electrical insulating material on the segment sides of said buss bars and slidably guided thereon for movement angularly about said segments, a bore in said block in the plane of each segment and the pertaining buss bar radial to the segments, a brush in each bore, a spring electrically connecting each brush with the adjacent buss bar and urging the brush into engagement with the periphery of the pertaining segment, a guard sheet of electrical insulating material covering said buss bars on the side opposite said block and slotted between said buss bars, a clamp member outside said guard sheet aligned with said block, and a clamp screw extending through said member and slot into screw-threaded engagement with the said block, said clamp member having an index mark thereon and said guard sheet having a calibrated scale to register therewith to provide an indication of the position of the said block along said buss bars.

18. In a switch; a frame having side walls, a plurality of rigid buss bars extending arcuately from one wall to the other and insulatingly supported thereon, a rotary segment in the plane of each buss bar concentric therewith and each having an angular portion of its periphery conductive and the remainder nonconductive, a brush means slidably engaging the periphery of each said segment and electrically connected with the pertaining buss bar, said brush means being adjustable along the buss bars independently of each other.

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