

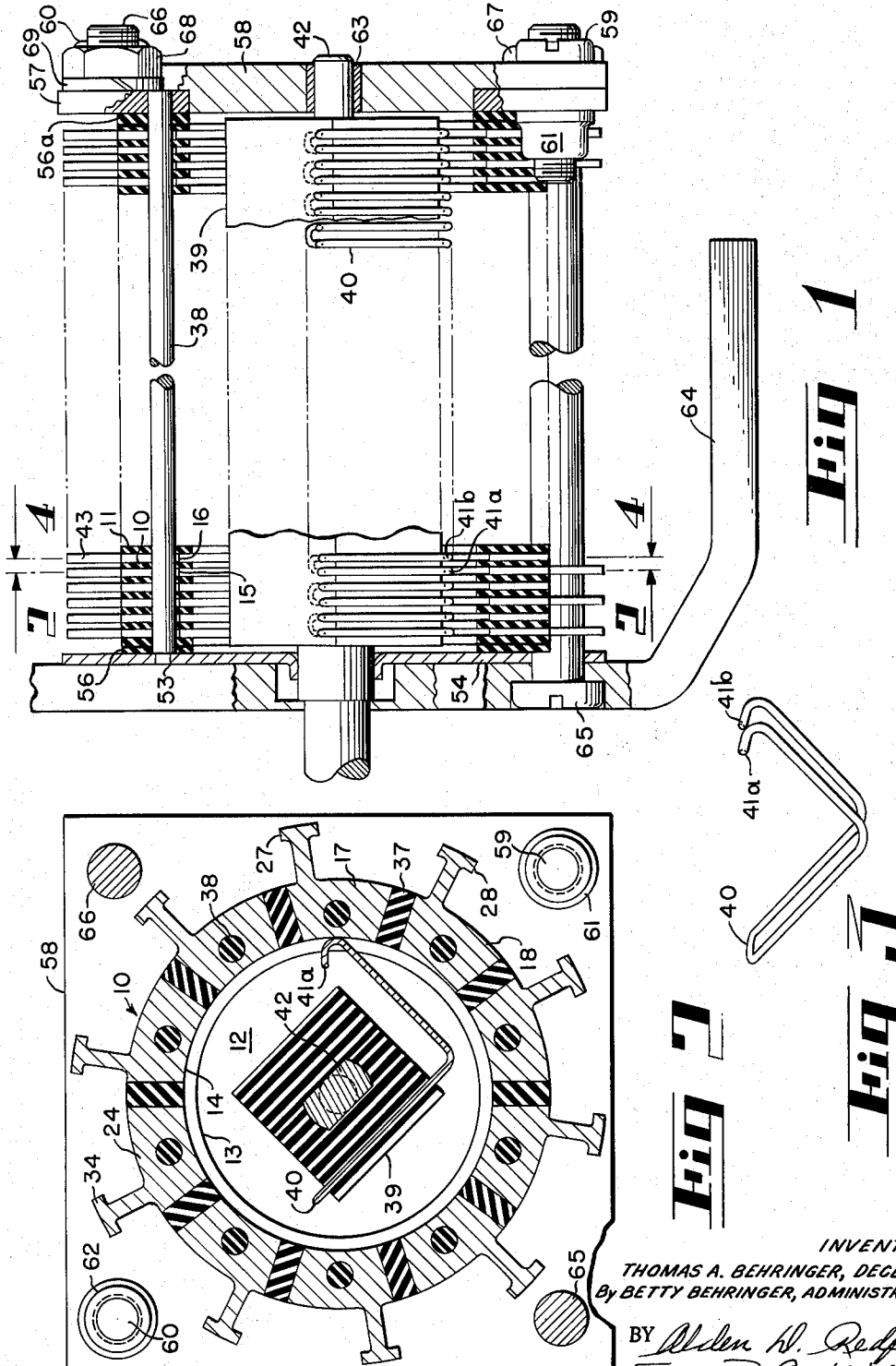
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T. A. BEHRINGER  
CONTACT WAFERS AND BIFURCATED CONTACTS  
IN HIGH SPEED SELECTOR SWITCHES

3,243,529

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2 Sheets-Sheet 1



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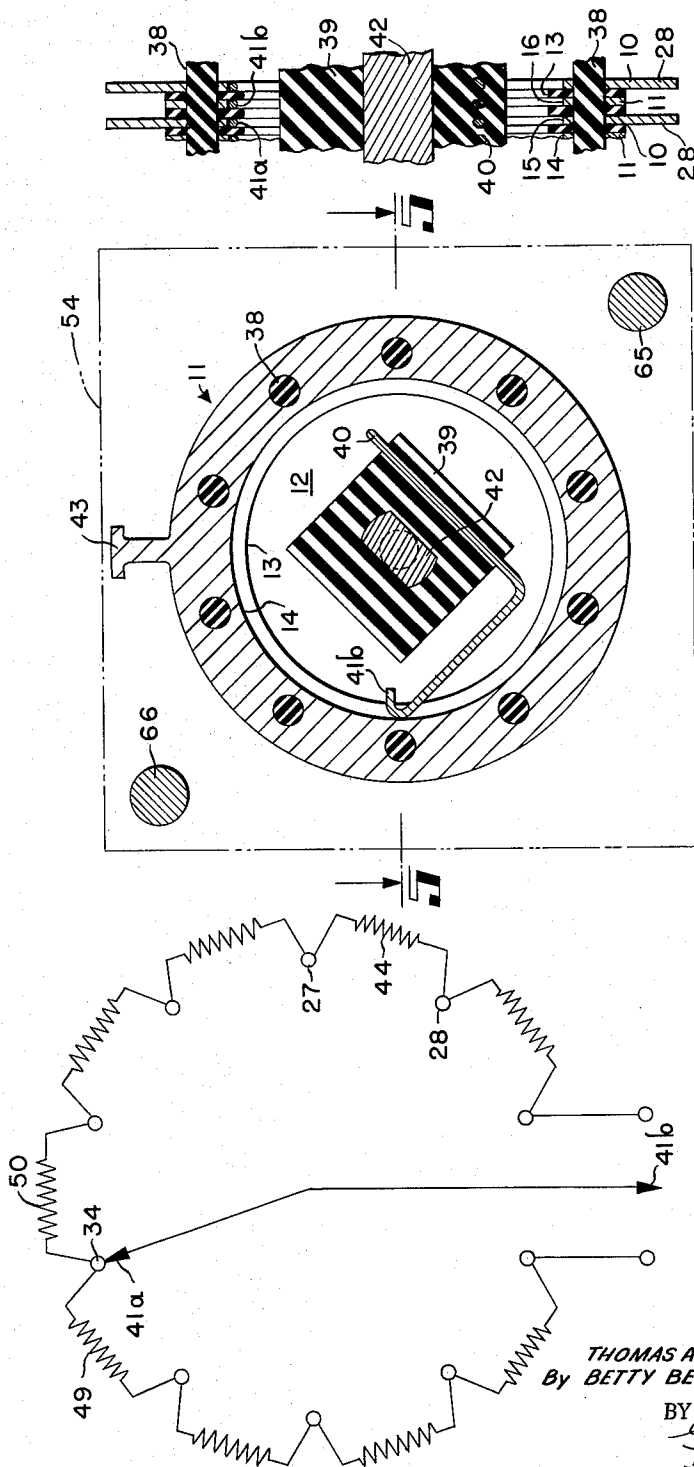
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## CONTACT WAFERS AND BIFURCATED CONTACTS IN HIGH SPEED SELECTOR SWITCHES

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The present invention relates to circuit selector switches, and specifically to a miniature multiple-rank, high-speed, continuously rotatable electric switch.

A broad object of the invention is to provide a multiple-pole, multiple-throw switch of high reliability for miniature component assemblies. A thirty-pole, ten-throw switch in accordance with the invention may be incorporated in a cylinder approximately one inch in diameter and one and a half inches in length.

A further object of the invention is to provide a selector switch for incorporation in subminiature communication equipment which has the advantages of high-speed, low-torque, essentially noise-free operation. The running torque may, for example, be in the order of three or four inch ounces for thirty-pole, ten-throw switch.

Further advantages reside in its inexpensive construction and long life cycle, estimated to be far in excess of a billion circuit selections.

For a better understanding of the invention, together with other and further objects, advantages, and capabilities thereof, reference is made to the following description of the accompanying drawings, in which:

FIG. 1 is an elevational view, partially in cross section, of high speed selector switch in accordance with the invention;

FIGS. 2 and 4 are cross-sectional views taken along lines 2—2 and 4—4, respectively, of FIG. 1 and looking in the direction of the arrows;

FIG. 3 is a perspective view of the electrical contactor employed in the illustrative embodiment of the invention;

FIG. 5 is a cross-sectional view taken along line 5—5 of FIG. 4; and

FIG. 6 is a circuit schematic showing an application of the switch to a voltage divider network.

Referring first specifically to FIGS. 2 and 4, there are shown two similar wafers 10 (FIG. 2) and 11 (FIG. 4) which together form one pole of the multiple-pole switch. Each is formed with a circular aperture 12, the diameter of which is greater at one face of the wafer than at the other, the reference numeral 13 indicating the face having the smaller-diameter opening, and the reference numeral 14 indicating the face having the large-diameter opening. When a plurality of paired wafers such as 10 and 11 are stacked with all of the wafers facing in the same direction, an annular groove such as those numbered 15 and 16 in FIG. 5 is formed between each pair of wafers.

In the illustrative embodiment herein shown the aperture has two different diameters, resulting in a step, and in cross section the bottom of the groove forms right angles with the sides. It is, however, within the scope of the invention for the walls of the aperture to slope from the larger diameter to the smaller, so that in cross section the groove forms an acute angle.

Again referring to FIG. 2, the face 14 of wafer 10 is divided into ten segments of conductive material 17, 18, 24, etc., separated by segments of non-conductive material 37. It will be understood that the number of conductive segments shown is merely illustrative; the invention contemplates as many as ninety switch contacts in a three-fourths inch diameter raceway. It is also within the scope of the invention to so dimension the switch

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segments and the conductors that one or more of the switch segments is in a conductive path at all times. Such operation is commonly referred to as "make-before-break" switching.

The face 13 of wafer 10 is of non-conductive material.

Each segment of conductive material such as 17 is provided with a terminal such as 27 for electrical connection to a specific circuit element.

Referring now to FIG. 4, the face 14 of wafer 11 is composed entirely of conducting material having a single terminal 43. As in the case of wafer 10, the face 13 of wafer 11 is of non-conducting material.

Wafers 10 and 11 are slidably mounted on a plurality of spaced mounting rods 38 (FIGS. 2, 4, and 5) which maintain the wafers in alignment.

Wafers 10 and 11 are of molded plastic, with the conductive material inlaid therein. An epoxy of Lexan is satisfactory for low-frequency, low-power operation. The thickness of the wafers may be in the order of .020 to .025 inch. The diameter of any specific stack of wafers will vary with the number of switch segments required for the particular application.

Centrally of the aperture 12 is a rotor 39 for mounting an electrical contactor or conductor 40. This conductor, bifurcated as shown in FIG. 3, is so mounted and dimensioned that its feet 41a and 41b contact the surfaces of grooves 15 and 16 (FIG. 5), respectively, and are guided by those grooves as the conductor rotates about the rotor shaft 42.

While the conductor herein shown has a U-shaped bight, it will be understood that a bifurcated conductor of any configuration may be used.

Conductor 40 is fabricated of precious metal alloys such as Paliney or Neyoro. These metals are an alloy of platinum, silver, and gold especially designed for long-life electrical contacts. The amount used per unit being very small, no excessive cost is incurred.

It will be seen that, as the conductor 40 rotates about shaft 42, the foot 41b is always in contact with the conducting surface 14 of wafer 11, while foot 41a alternately brushes conductive segments and segments of insulating material on the face 14 of wafer 10. In the position shown in FIG. 2, foot 41a is in contact with conductive segment 17, thereby connecting terminal 27 in circuit with the conductive face 14 of wafer 11, and hence to terminal 43.

Conductor 40 is spring-biased against the grooves at a pressure of approximately ten grams.

A single unit comprising a single-pole, ten-throw switch having been described in detail, the description now proceeds to FIG. 1, wherein is shown a plurality of such units assembled to form a multiple-pole, multiple-throw selector switch.

In FIG. 1 a plurality of paired wafers such as 10 and 11 are shown stacked and held in alignment by mounting rods 38. At one end of the stack of wafers, rods 38 are press-fitted into apertures 53 provided in a bearing plate 54, which is also centrally apertured to receive rotor shaft 42.

Between the stack of paired wafers and bearing plate 54 is a single wafer 56 of insulating material, the aperture of which has a diameter equal to the smaller-diameter apertures of wafers 10 and 11. A similar wafer 56a, also of insulating material, is provided between the opposite end of the stack of paired wafers and an end ring 57 which is apertured to receive the free ends of rods 38.

The assembly of wafers, rods, and end ring is closed by an end plate 58 secured at two diagonal corners to end ring 57 by means of bolts 59, 60 and nuts 61, 62 (FIGS. 1 and 2). End plate 58 is centrally apertured to receive rotor shaft 42, supported in its bushing 63.

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The assembly of bearing plate, wafers, rods, end ring, and end plate thus far described may then be supported on a mounting bracket 64, which is suitably apertured to receive rotor shaft 42, to secure the assembly to the interior wall of a radio cabinet, for example. As shown in FIG. 1, bolts 65, 66 project through apertures in diagonal corners of mounting bracket 64 and through apertures in the free diagonal corners of end ring 57 and end plate 58, and nuts 67, 68 are tightened against washers such as 69 to secure the switch assembly in place. Conversely, removal of nuts 67, 68 permits the entire switch assembly to be quickly and easily lifted from its mounting.

It will be noted that, as rotor 39 turns in response to manual or motor-driven rotation of shaft 42, the conductors 40 move in unison, so that the combination of elements encircled thereby at any one position of the rotor is dependent on the specific design of the switch segments at each pole and the circuit connections thereto.

Referring now to FIG. 6, there is shown an application of one pole of the selector switch to a voltage divider, resistors 44, 49, 50, etc., being connected in series between the terminals 27, 28, 34, etc., of FIG. 2. Foot 41a of the conductor 40 is effectively in contact with terminal 34 of conducting segment 24, thus connecting terminal 34 through foot 41b of conductor 40 to terminal 43 (FIG. 4).

While the illustrative embodiment of the invention herein described is basically a subminiature switch designed for low-power handling at frequencies up to the high frequency range, minor variations in the design will permit operation at much higher frequencies, including the ultra-high-frequency range. The demand for greater power handling may be satisfied by increasing the current-carrying elements of the device to a compatible size.

The selector switch in accordance with the invention has the advantage of great versatility. Any combination of one to hundreds of poles is readily available. Wafers cast with varying numbers of switch segments may be quickly assembled in any combination. This affords a major advantage in field operation and maintenance. Switches may be assembled and installed on location to order from a relatively small stock of parts.

While there has been shown and described what is at present considered to be the preferred embodiment of the invention, it will be obvious to those skilled in the art that various modifications and changes may be made therein without departing from the true scope of the invention as defined by the appended claims.

What is claimed is:

1. A continuously rotatable multipositional switch comprising:

a plurality of similar wafers each having a circular aperture therethrough, the diameter of said aperture at one face of said wafer being smaller than the diameter of said aperture at the other face, said plurality of wafers being stacked one upon the other in the same direction with said apertures coaxial,

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successive pairs of wafers together forming successive annular grooves with lands between said grooves; each of said wafers being fabricated of insulating material adjacent said one face, and at least segments adjacent said other face being fabricated of conducting material;

a two-legged bifurcated conductor for each successive pair of grooves;

means for supporting said conductor for rotation about the axis of said apertures, the legs of said conductor bridging the land between said grooves and contacting the surfaces of said pair of grooves;

and electrical connections to said segments of conducting material.

2. A switch in accordance with claim 1 and means for rotating the conductor-supporting means.

3. A switch in accordance with claim 2 in which the wafers are mounted on a plurality of spaced rods.

4. A switch in accordance with claim 3 in which said other face of alternate wafers is comprised entirely of conducting material, and said other face of the remaining wafers is comprised of segments of conducting material separated by segments of insulating material.

5. A multiple-pole, multiple-throw rotary switch comprising:

a plurality of stacked wafers having identical circular apertures in alignment, the diameter of said apertures being greater at one face of said wafers than at the other, thereby forming a plurality of annular grooves;

the portions of said wafers adjacent the faces having the smaller-diameter apertures being of insulating material, and at least segments adjacent the faces having the larger-diameter apertures being of conducting material;

a plurality of bifurcated conductors, the forks of each conductor contacting the surfaces of two adjacent grooves;

and means for supporting said conductors for rotation about the axis of the apertures.

6. A switch in accordance with claim 5 in which all of the wafers face in the same direction.

7. A switch in accordance with claim 6 in which said other face of alternate wafers is comprised entirely of conducting material, and said other face of the remaining wafers is comprised of segments of conducting material separated by segments of insulating material.

8. A switch in accordance with claim 5 in which the wafers are mounted on a plurality of spaced rods.

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