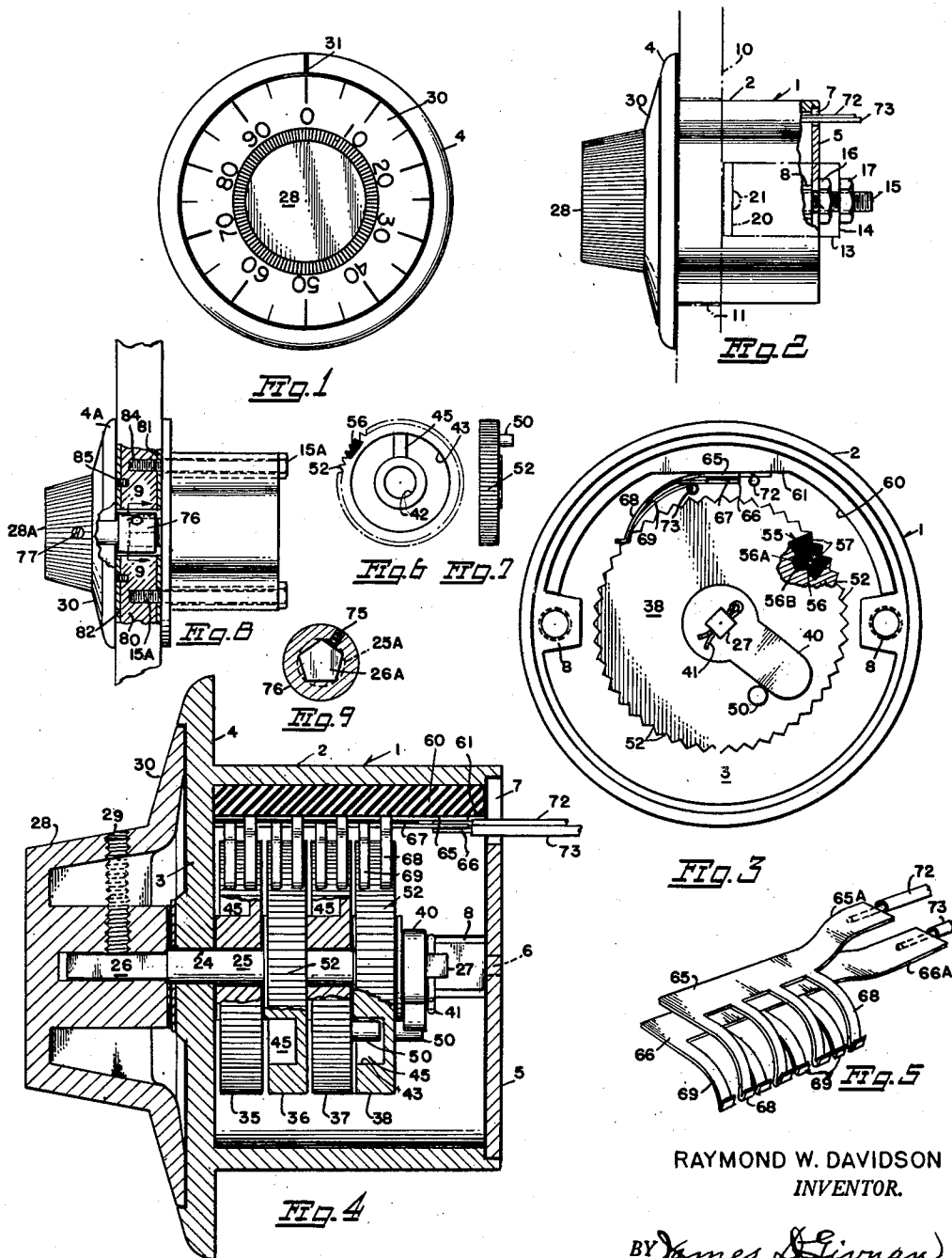


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PERMUTATION SWITCH WITH A PAIR OF BUS BARS EACH
HAVING SPACED APART INTEGRAL SPRING FINGERS
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PERMUTATION SWITCH WITH A PAIR OF BUS BARS EACH HAVING SPACED APART INTEGRAL SPRING FINGERS

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This invention relates to improvements in permutation switches of the general type shown and described in my United States Letters Patent No. 2,984,717. The general object of the present invention is to improve upon the type of switch shown in that patent wherein a plurality of disc-like tumblers arranged for free selective rotation about a tubular fixed shaft mounted in one end of a case, are provided with segmental peripheries consisting in respective conductor and insulator segments, and are arranged for engagement of said peripheries by a plurality of contact brushes which are mounted on the inside of and insulated from the lateral wall of the case and project radially inwardly into contact with the tubular peripheries.

The principal objects of the present invention are to provide an improved and simplified construction of tumbler actuating and inter-engaging means; an improved and simplified construction and arrangement of contact brushes, adjustable and settable means interconnecting the tumbler supporting shaft and actuating means therefor, and similar means interconnecting the tumbler shaft with tumbler pick-up means whereby the various combinations that can be assigned to the switch are of greater magnitude than any other that I am aware of.

The foregoing and other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawing forming a part hereof, wherein like numerals refer to like parts throughout the several views, and in which:

FIGURE 1 is a front elevational view of a permutation switch made in accordance with my invention.

FIGURE 2 is a side elevational view of FIGURE 1 with a fragment broken away for convenience of illustration and showing in broken lines mounting means for the switch.

FIGURE 3 is a view of the right hand side of FIGURE 2 on an enlarged scale and with the mounting flange removed.

FIGURE 4 is an axial sectional view of FIGURE 2 on an enlarged scale with fragments of the tumblers therein broken away.

FIGURE 5 is a perspective detail view of a pair of bus-bars and brush contacts integrated therewith.

FIGURES 6 and 7 are front and side elevational views respectively of a typical tumbler.

FIGURE 8 is a side elevational view of a modified form of the invention and mounting means therefor with fragments broken away for convenience of illustration, and

FIGURE 9 is a sectional detail view on an enlarged scale taken approximately along the line 9—9 of FIGURE 8.

With continuing reference to the drawing, reference numeral 1 indicates generally a casing having a cylindrical lateral wall 2, an integrated closure wall 3 and mounting flange 4 as its forward end, and a removable disc 5 closing the rearward end. The disc is provided with diametrically opposed apertures 6 and an upwardly opening recess 7. Similarly opposed internally threaded bosses 8 are integrated with the interior wall of the casing.

By this arrangement, as best illustrated in FIGURE 2, the switch may be mounted to a wall 10 or similar support by extending the casing 1 through an opening 11 in the wall and abutting the mounting flange 4 against the outside of the wall. The switch is secured to the wall by means of a generally U-shaped bracket 13 through whose cross member 14 studs 15 extend and threadedly engage the internally threaded bosses 8. Lock nuts 16 and 17 are applied to the studs on the inside and outside of the bracket cross member 14, and the feet 20 of the bracket are secured to the inside of the wall 10 by screws 21.

Journalled as at 24 in the front closure wall 3 of casing 1 is a round tumbler-supporting shaft 25 (see FIG. 4) of square section at its forward and rearward ends as at 26 and 27 respectively. A dialing knob 28, removably secured as at 29 to the front end of the shaft, has its flange 30 (FIG. 1) inscribed with numbered indicator marks as shown, cooperable with a fixed indicator mark or reference point 31 on the rim of the mounting flange 4.

Rotatably mounted upon the shaft 25 are a series of identical tumblers 35, 36, 37 and 38 maintained on the shaft by an actuator arm 40 on the squared inner end 27 thereof and a cotter pin 41 extending through that end of the shaft. Each tumbler is generally in the form of a flat circular disc having a central opening 42 therethrough for rotatable mounting on shaft 25, and a forwardly opening annular recess 43 therein with a radially disposed driving web across the recess as at 45. The opposite or rearward side of each tumbler disc is provided with a driving pin 50, and the rim of each disc is provided with adjoining V-notches 52 to define between them respective transverse ridges of triangular section as shown in FIGURES 3 and 6.

Each tumbler is made of metal or other conductive material such, for example, as that used in die casting and its rim is provided with a groove 55 undercut on both of its sides as shown to receive by a forced fit a segment 56 of dielectric material provided on its exterior with transverse V-notches 57 matching in shape and continuity the V-notches 52 in the rim of the tumbler. The inner or bottom surface of each segment 56 (FIG. 3) is provided with a nodule 56A for similar engagement with a receiving recess 56B in the bottom wall of the groove to thus securely mount the segment within the respective groove 55.

A semi-cylindrical mounting plate 60 of dielectric material, such as synthetic resin plastic, having a chordal inner face 61 to provide strengthening thickness thereacross, is injection molded to fit snugly within the arcuate space defined between the circumferentially spaced bosses 8 with the side edges of the mounting plate bearing against the bosses, as shown. The mounting plate is secured in place by securement of the closure disc 5 to the bosses 8 by means of the studs 15.

Two bus-bars 65 and 66 (FIG. 5) disposed one above the other with insulation 67 therebetween (FIG. 4) are of flat formation throughout their length and integrated with outwardly extending spring contact fingers 68 and 69 respectively curved downwardly on unlike radii of curvature, as best shown in FIGURE 5, before assembly with the tumblers within the casing 1, terminating in tip ends of angular formation on a common horizontal plane and matching the angularity of the V-notches 52 and 57 for positive engagement therewith after assembly with the tumblers to effect initial resistance in said spring fingers against unintentional rotation of the tumblers in either direction. The resistance of the spring fingers re-acts through the mounting plate and the sides thereof against the bosses 8. It will be plainly seen in FIGURE 3 that the reach of the spring fingers 68—69 in both series, when in tension, resulting from such assembly, assume a position

substantially tangential to the peripheral surfaces of the tumblers 35-38. This makes possible the utilization of a cylindrical casing 1 having minimal inside and outside diameters despite the length of the spring fingers and their effective spring-pawl like engagement with the V-notches in the tumblers. The rearward ends 65A and 66A of the bus-bars are spread apart laterally and to these ends electrical conductors 72 and 73 are secured by soldering or the like. The insulation 67 between the bus-bars 65 and 66 is of the same material as the mounting plate 60 and in securing both bus-bars to each other and to the mounting plate it is merely necessary to apply a hot iron to weld the components into an integral assembly or the contiguous surfaces thereof could be coated with suitable adhesive. The conductors 72 and 73 extend outwardly through the recess 7 in the disc 5 and are in closed circuit with a source (not shown) of electrical current and for example an electrical lock-actuating mechanism (not shown) such as a solenoid and core, or the like, wherein the core is adapted to function as a locking bolt when the solenoid is energized. The conductors could also be in circuit with an alarm through conductor tape, such as is used on jewelry store windows, vaults, safes and the like, in burglar alarm systems wherein when the circuit is broken the alarm is energized.

The bus-bars 65 and 66 are installed as aforesaid and in such manner that their angular tips are at all times spring-urged into firm, non-slipping but removable engagement with the V-notches of their respective tumbler discs 35-38. From the foregoing it will be readily apparent that an electrical circuit through the bus-bars will remain closed as long as any two of the contact fingers 68-69 are in contact with their respective tumbler and that the circuit can only be broken when all the contact fingers are in contact with the dielectric segments 56 of their respective tumblers. Such making and breaking the electrical circuit can only be accomplished by rotating the tumblers relative to each other about their supporting shaft 25 by means of the dialing knob 28 and then only by an authorized person who has knowledge of the number of turns to the right or left thereof to bring the various numbered indicator marks on the dial flange 30 into registry with the fixed indicator mark 31 on the rim of the flange 4.

In the initial rotation of the knob 28 and actuator arm 40 they will be rotated several revolutions, so as to cause the driving pins 50 of successive tumblers, beginning with tumbler 38, to inter-engage with driving webs of adjacent tumblers so that the successive tumblers will in turn be "picked up" and rotated along with tumbler 38. The first stop at the indicator mark 31 will result in the dielectric segment 56 of the first tumbler 35 being brought into engagement with its respective contact fingers 68 and 69 of the bus-bars 65 and 66 thus initially breaking the circuit only through those two contact fingers.

With the first tumbler 35 now held against rotation by the angular tips of the contact fingers in engagement with the matching V-notches in the dielectric segment, the dialing knob 28 is rotated in the opposite direction, one turn less than previously, causing actuator arm 40 to first disengage from one side of driving pin 50 of the fourth or foremost tumbler 38 and rotate around into engagement with the other side of said pin causing driving web 45 of tumbler 38 to pick up pin 50 of the third tumbler 37 to rotate the same in said opposite direction. Web 45 of tumbler 37 will pick up pin 50 of the second tumbler 36 to rotate the same until its dielectric segment 56 is engaged by the tips of its respective contact fingers and so held against further rotation. With the tumblers 35 and 36 now in the positions just mentioned, the circuit has been successively broken through their respective contact fingers. Rotation of the dialing knob 28 and actuator arm 40 in an opposite direction will similarly impart rotation to the third tumbler 37 to position its dielectric segment and respective contact fingers in circuit-open position.

Rotation of dialing knob and actuator arm in a reverse direction will finally position the dielectric segment of the rearmost tumbler 38 in circuit-open engagement with its respective contact fingers and thus completely break the circuit through the bus-bars 65 and 66 and the conductors 72 and 73 leading therefrom.

All of the dialing operations just described, to be effective, must be done in accordance with the numerical combinations assigned to the switch in its entirety, and such combinations can be quickly and conveniently varied by rotatably re-setting the actuator arm 40 and dialing knob on their respective squared ends of the tumbler-supporting shaft 25.

In the modified form of the invention shown in FIGURE 8, the numerical combinations can be varied to an even greater extent because of the configuration of the knob-end 26A of tumbler-supporting shaft 25A which may be that as shown, or of hexagonal, octagonal or any other multi-faced or non-circular section and fitted within and secured, as at 75, to one end of a matching coupling 76 whose opposite end is of square section for securement as at 77 to the dialing knob 28A.

In this modification the switch in its entirety is shown secured to a support which, for example, could be the front wall of a drawer of a filing cabinet or similar storage receptacle wherein said support comprises a heavy steel main wall 80 and inner and outer walls 81 and 82. The studs 15A extend through the inner wall 81 and into threaded securement with drilled and tapped holes 84 in the main wall 80. Similarly the mounting flange 4A of the closure wall 3A is secured to the outer wall 52 and main wall 80 by screws 85.

From the foregoing it will be apparent that I have provided a permutation switch which is of greatly simplified and improved construction containing a minimum number of parts to obtain optimum results and wherein such simplified construction essentially includes, the unitary tumbler supporting means, the novel dielectric segments and their mounting in the tumblers, the novel bus-bar assembly and contact fingers integrated therewith, and the novel formation of the ends of the tumbler-supporting shaft and matching openings in the actuator arm and dialing knob for varying numerical combinations assigned to the switch to a greater magnitude than in any comparable device that I am aware of.

While I have shown and described particular forms of embodiment of my invention, I am aware that many minor changes therein will suggest themselves to others skilled in the art without departing from the spirit and scope of the invention. Having thus described my invention, what I claim as new and desire to protect by Letters Patent is:

1. In a permutation switch including a hollow cylindrical casing closed at both of its ends having a plurality of cylindrical tumblers rotatably mounted therein which have conducting and non-conducting surface portions, electrical conductors extending to the interior of the housing, and a semi-cylindrical mounting plate supported within the casing and having a relatively thick chordal inner face, the improvement comprising:

a pair of bus bars of flat formation throughout their length secured to and spaced from each other by a dielectric bonding material throughout the major portion of their length and divided outwardly beyond one end of said bond into two conductive terminals electrically connected to said conductors; both bus bars being bonded as a unit throughout their said major portion to said chordal inner face of said mounting plate;

each of said bus bars having laterally, outwardly extending, spaced apart integral spring contact fingers curved downwardly, the fingers of one of said bars straddling those of the other of said bars to provide a series of pairs, each finger of said pair being connected to a separate bar;

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the fingers of one of said bars having a common radius of curvature unlike the common radius of curvature of the fingers of the other of said bars, said fingers all terminating in tip ends of angular formation lying in a common plane;

each pair of adjacent fingers from said respective bars being in frictional contact in said common plane with the cylindrical periphery of one of said rotatable tumblers;

whereby a multiple switch circuit may be provided by the use of only two integral conductive elements and whereby stresses applied to said elongated spring fingers by the rotation of said tumblers will be absorbed by the resiliency of the spring fingers within the length thereof with minimal transfer to the bus bars and to their bonding components.

2. A structure as set forth in claim 1, wherein said

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spring contact fingers are all substantially tangential to the peripheral surfaces of said tumblers.

References Cited by the Examiner

UNITED STATES PATENTS

1,156,121	10/15	Wise	200—43
1,185,690	6/16	Lawrence	200—43
1,673,607	6/28	Tulloch	200—45
2,528,746	11/50	Giffin	200—45
2,797,271	6/57	Augustine	200—43
2,934,615	4/60	Goral	200—45
2,984,717	5/61	Davidson	200—45

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