

[54] **DIAL TYPE WAFER PRINTED CIRCUIT SWITCH**

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[52] U.S. Cl. **200/11 DA**

[51] Int. Cl. **H01h 19/58, H01h 21/78**

[58] Field of Search..... 200/11 D, 11; 317/101 B

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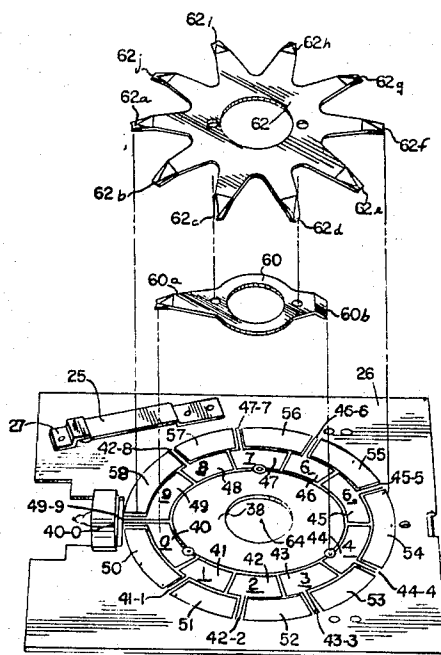
Attorney, Agent, or Firm—Walter C. Kehm; Samson B. Leavitt

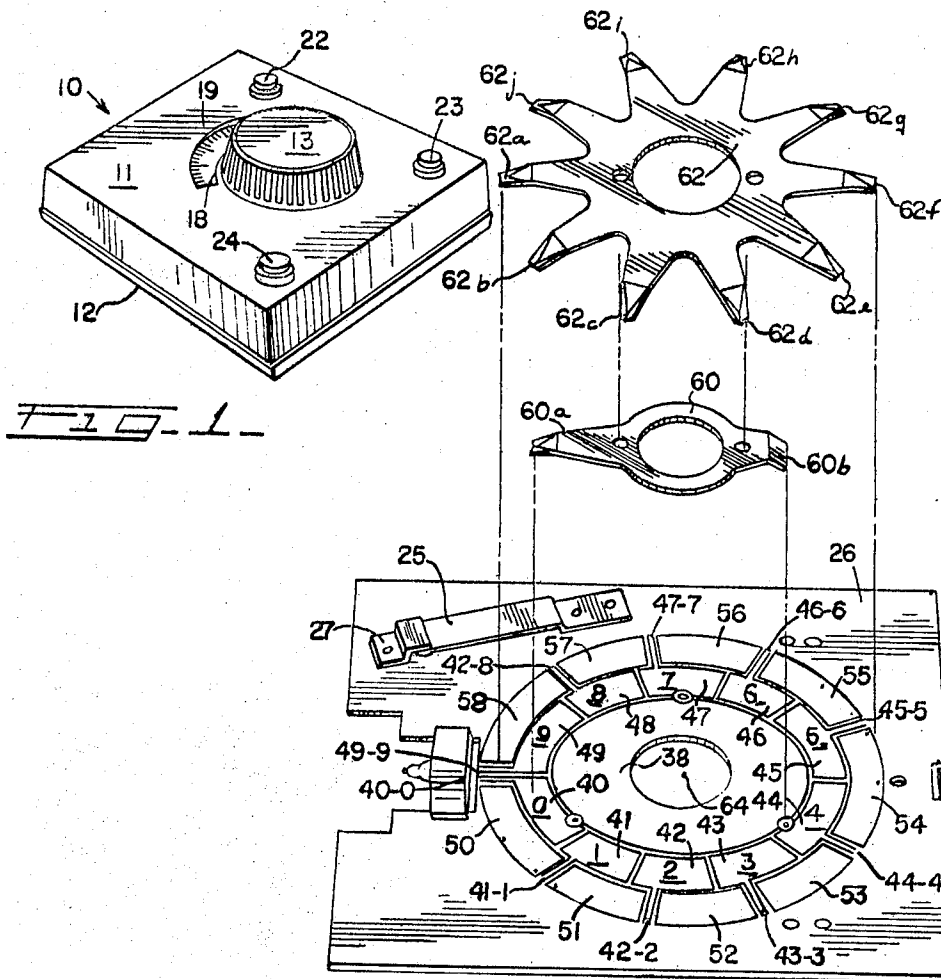
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ABSTRACT

Ten fixed contacts are arranged in an annular pattern; these members define "tens" contacts. Ten fixed "units" contacts are arranged to lie on an imaginary circle concentric with said annular pattern. A movable contact wiper is arranged for one-at-a-time engagement with the "tens" contacts. A member with ten radially extending contact fingers is mounted for rotation and is arranged such that only one of such fingers contacts only one of the "units" contacts at any one time. The contact wiper is mounted for rotation with the contact fingers; during a complete revolution of these two members one hundred switching operations are achieved.

15 Claims, 6 Drawing Figures





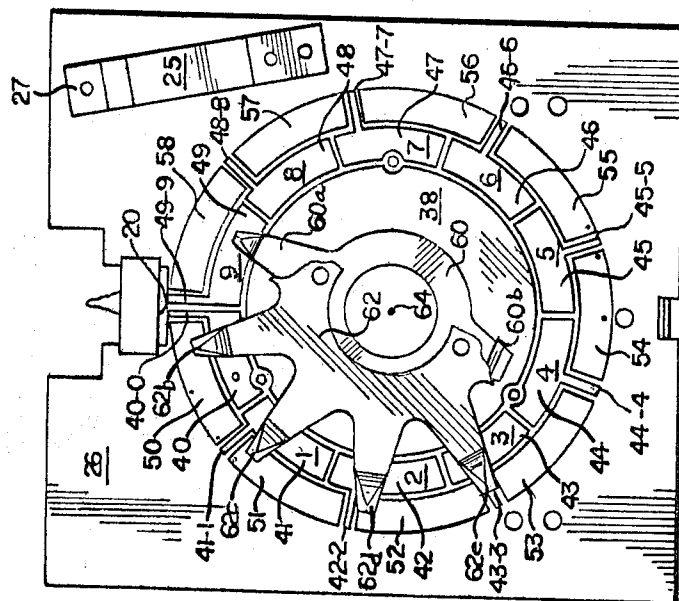


FIG. 3-

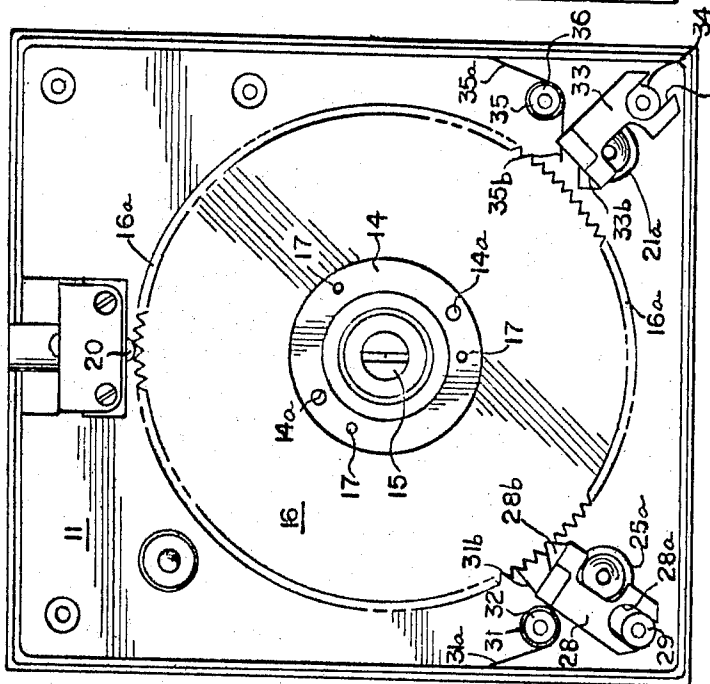
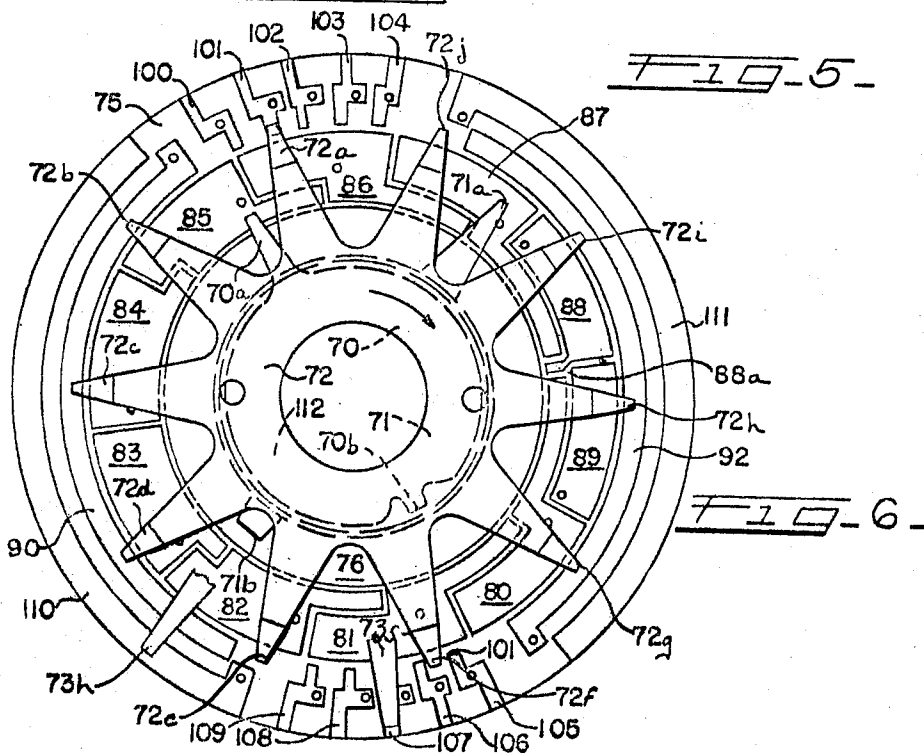
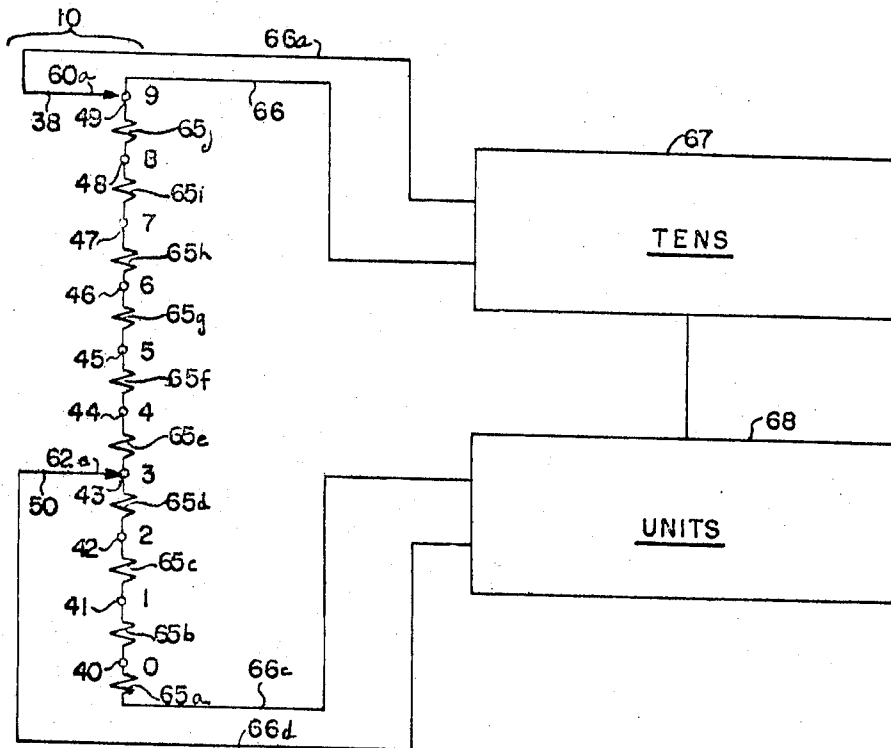


FIG. 4-



DIAL TYPE WAFER PRINTED CIRCUIT SWITCH

This application is a continuation-in-part of my application, Ser. No. 834,040, filed June 17, 1969 now U.S. Pat. No. 3,733,122.

OBJECTS OF THE INVENTION

A primary object of the present invention is the provision of a new and improved switching device for a slide projector random selection circuit or the like.

Another object of the present invention is the provision of such a switching device wherein arcuate fixed contacts cooperate with movable contact fingers to provide a unique switching arrangement utilizing a minimum of contact elements.

Still another object of the present invention is the provision of a switching device of the type described wherein "tens" contact formations and "units" contact formations are constituted by the same contact strips.

Another object of the present invention is the provision of a new and improved switching device of the type described which alternately provides for first and second total numbers of switching sequences for one complete revolution of certain movable contacts with respect to the associated fixed contacts.

These and other objects and advantages of the invention will become apparent from the following specification disclosing a preferred embodiment shown in the accompanying drawings.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is an isometric view of one embodiment of the present invention shown in the form of remote input or control console for a random selection slide projector;

FIG. 2 is an exploded isometric view of the contact members contained within the control console of FIG. 1;

FIG. 3 is a top plan view of such contacts;

FIG. 4 is a bottom plan view of the upper housing member of the control console showing primarily an indicia bearing disk;

FIG. 5 is a schematic of an electric circuit with which the present invention may be associated; and

FIG. 6 is a top plan view of a switching device constituting another embodiment of the present invention which may be used in the slide projector controlled by the remote console shown in FIG. 1.

DESCRIPTION OF PREFERRED EMBODIMENTS

Referring primarily to FIG. 1, the remote input or control console, generally designated 10, includes an upper housing or shell 11 suitably secured to a lower housing piece or base plate 12. A knurled control knob 13 is rotatably supported in an aperture in the shell 11, such knob being mounted to a hub member 14, as by means of a fastener 15. It will be understood that rotation of the knob 13 imparts corresponding rotation to the hub 14.

The hub 14 mounts an indicia bearing disk 16 by means of a plurality of small fasteners 17. This disk carries peripherally arranged indicia in the form of numerals from "1" to "100" in the embodiment shown for purposes of illustration, a segmental portion of such indicia being visible through a window 18 formed in the shell 11. A mark 19 is formed on the shell 11 adjacent

one margin of the window 18 to establish a reference line for the indicia on the disk 16. In other words, the knob 13 is rotated as appropriate to position the selected number on the disk 16 in alignment with the mark 19.

To facilitate positioning of selected numbers on the disk 16 in alignment with the reference mark 19, the disk 16 includes one hundred peripheral indexing teeth 16a engageable by a spring biased detent button 20. It will be understood that this indexing mechanism permits the disk 16, and consequently the hub 14, to come to rest only when one of the numbers on such disk is in alignment with the reference mark 19.

The console 10 mounts an "actuate" button 22, a "forward" button 23 and a "reverse" button 24. The actuate button 22 is biased in an up position. When such button is depressed, the same engages a spring contact strip 25 and thereby forces the latter into engagement with a contact button (not shown), the latter as well as the spring strip 25 being mounted on an insulating board 26 which may be formed of a phenolic material or other suitable dielectric material. The spring strip 25 is biased out of engagement with the associated fixed contact, the distal end of the former being restrained by a clip 27 mounted on the board 26. It will be understood that the contact 25 and its associated fixed contact define an actuate switch for the random selection circuit to be referred to hereinbelow.

Referring to FIG. 4, the forward indexing button 23 includes a frusto-conical camming formation 23a engageable with a complementary surface on a forward indexing member 28. The member 28 has a recess 28a rockably and slidably receiving a pin 29, the latter being fixedly supported from the underside of the shell 11. This indexing member includes a pawl formation 28b engageable with the teeth 16a on the disk 16. A wire spring 31 is supported by a pin 32, which pin is mounted from the shell 11. This wire has opposite ends 31a, 31b respectively engaging the indexing member 28 and a side wall of the shell 11 for urging the member 28 to a position wherein the pawl 28b is out of engagement with the teeth 16a. When the button 23 is depressed, the member 28 is cammed against the force of the spring wire so as to bring the pawl 28b into engagement with the teeth 16a and step the disk 16 in a forward direction by an amount so as to bring the successive number on the disk 16 into alignment with the reference mark 19.

Similarly, the reverse button 24 includes a frusto-conical formation 24a for camming engagement with a complementary surface on a reverse indexing member 33, the latter having a recess 33a receiving a pin 34. The member 33 includes an integral pawl 33b for engagement with the teeth 16a. A spring 35 mounted on a pin 36 has opposite ends 35a and 35b urging the member 33 to the position shown in FIG. 4. It will be understood that when the reverse button 24 is depressed, the pawl 33b comes into engagement with the teeth 16a for rotating the disk 16 in a reverse direction by an amount for positioning the preceding number on the disk 16 into alignment with the reference mark 19.

At this time it should be mentioned that the remote console or unit 10 embodying the present invention may be connected with a random selection slide projector by a suitable cable, which slide projector (not shown) may embody the random selection circuit dis-

closed and claimed in my copending application mentioned above. The knob 13 is rotated for selecting any number from "1" to "100," such numbers corresponding respectively to the spaces within a "100 slide circular tray." If it is desired to project the successive slide or the immediately preceding slide, such slides may be selected either by manipulation of the knob 13 or by actuation of the buttons 23, 24. Other selections may be achieved by manipulation of the knob 13 or by repeated actuation of the buttons 23, 24 as desired.

Turning now to FIGS. 2 and 3, the board 26 mounts an annular contact plate 38. Ten arcuate contacts 40 through 49 are mounted around the periphery of the plate 38 in spaced relation with the latter thereby defining an annular pattern. These contacts may be characterized as "tens" contacts. The contacts 40 through 49 have respective, integral, radially extending portions 40-0 through 49-9. These radially extending contact formations may be characterized as "units" contacts. The contacts 40-0 through 49-9 are arranged to lie on a circle concentric with the annular pattern defined by the "tens" contacts 40 through 49.

The "tens" contacts are segmental in shape and are of equal arcuate extent. The "units" contacts 40-0 through 49-9 are equally spaced from each other proceeding counterclockwise as viewed in FIG. 3; however, it will be noted that the "units" contacts 40-0 and 49-9 are closely spaced with respect to each other. These "units" contacts may be characterized as defining nine equal chords of an imaginary circle and one chord substantially shorter than any one of such equal chords.

The "units" contacts are separated by nine segmental contacts 50 through 58 of equal arcuate extent. One of these contacts, e.g., the contact 50, acts as a common contact for the "units" contacts. The annular contact 38 acts as a common contact for the "tens" contacts 40 through 49.

The hub 14 mounts a movable contact 60, as by means of a pair of pin formations 14a on the former received within suitable apertures on the latter. This movable contact includes a wiper finger 60a arranged for one-at-a-time wiping or sliding engagement with the "tens" contacts 40 through 49. This movable contact has another wiper finger 60b arranged for continuous sliding engagement with the common contact 38.

Also mounted on the hub 14 for rotation therewith is another movable contact 62 having ten radially extending, equally spaced, contact fingers 62a through 62j. These contact fingers are arranged for wiping engagement with the "units" contacts 40-0 through 49-9 and with the segmental contacts 50 through 58. The spacing of these contact fingers on the movable contact 62 and the spacing of the "units" contacts are such that only one of the contact fingers 62a through 62j may engage only one of the "units" contacts 40-0 through 49-9 at any one time. This spacing is such that one of the fingers 62a through 62j will always be in engagement with the common contact 50.

It should be mentioned that all of the fixed contact strips on the board 26 are preferably formed of copper or other good conducting material printed or otherwise formed on such board. The movable contacts 60, 62 are also preferably made of copper and move in unison upon rotation of the knob 13.

In FIG. 3, the contacts are arranged to define number "93," this resulting because the contact wiper 60a is in

engagement with the "tens" contact 49, which represents "90," and because the contact finger 62e is in engagement with "units" contact 43-3, which represents "3."

It will be understood that the wiper finger 60a and the contact finger 62a lie in a common vertical plane perpendicular to the board 26 and passing through the center of rotation designated 64. The "100" position, which may also be characterized as a "0" position, is defined when the wiper finger 60a engages the extreme right hand portion (as viewed in FIG. 3) of the "tens" contact 40 and when the contact finger 62a engages the "units" contact 40-0. The "tens" contacts 40 through 49 constitute "tens" from "00" to "90," respectively. The "units" contacts 40-0 through 49-9 constitute "units" from "0" to "9."

As soon as the movable contacts are rotated in a counterclockwise direction (as viewed in FIG. 3) from the "100" position as just described, the contact finger 62b will engage the "units" contact 41-1 simultaneously with disengagement of the contact finger 62a from the "units" contact 40-0 thereby to define the "01" position. On the next increment of counterclockwise rotation of the movable contacts, the contact finger 62c will engage the "units" contact 42-2 simultaneously with disengagement of contact finger 62b with the "units" contact 41-1 thereby to define the "02" position.

During the aforescribed movement of the contact fingers 62a through 62c, the wiper 60a will remain in contact with the "tens" contact 40 which represents "00." However, as the contact finger 62j comes into engagement with the "units" contact 40-0, the wiper 60a will simultaneously come into engagement with the "tens" contact 41 (representing "10") thereby to define the "10" position.

It should now be apparent that for one complete revolution of the movable contacts 60, 62 with respect to the fixed contact strips on the board 26, one hundred switching sequences are achieved. The wiper 60a engaging the "tens" contacts 40 through 49 will establish ten contact positions, and during the time each of these contacts is wiped by the finger 60a, i.e., during each 36° of rotation, the contact fingers 62a through 62j will establish ten contact sequences or switching arrangements. One of the fingers 62a through 62j is always in engagement with the contact 50 which acts as a common "units" contact; the finger 60b is always in engagement with the annular contact 38 which acts as a common "tens" contact. When the knob 13 is rotated to select a number, the contacts 60, 62 will thereby be moved to engage the fixed contacts for establishing the corresponding switching pattern.

Referring to FIG. 5, the contact strips 40 through 49 are connected in a network of series arranged resistors 65a through 65j. Since the "tens" contacts 40 through 49 are integral with the "units" contacts 40-0 through 49-9, one set of resistors serves both the "tens" and "units" functions. As noted, the movable contact fingers 60a and 62e are in engagement with contact plates 49 and 43 (portion 43-3) respectively, thereby defining input selection "93" and corresponding with the disposition of the contacts as illustrated in FIG. 3.

This resistor network and the movable contacts are connected to the associated slide projector by conductors 66a, 66b, 66c and 66d, all contained within a suitable cable extending between such projector and the

remote control console 10. (The lines for the actuate switch in the handpiece 10 are not illustrated in FIG. 5) The random selection circuitry and associated contacts within the projector are shown only in block form in FIG. 5 as a "tens" section 67 and a "units" section 68.

It should be apparent that for each position of the knob 13 a predetermined electrical resistance will be established by the contacts controlled thereby and that the resistance for each position will be different from the resistances for all other positions. Reference may be had to the parent application identified above for a complete description of the random selection circuitry and associated components within the projector which utilize such input information. Briefly, the circuitry shown in that application operates by what may be termed a balanced resistance principle. According to this principle, when the selector knob on the control console is actuated to select a certain slide space in the tray, the contact members moved during this operation cause a switching function to establish a predetermined electric resistance. Each selection of spaces within the tray results in a different resistance value. A network of resistors is contained within the slide projector and is associated with fixed and movable contacts to establish a predetermined electrical resistance for each of the positions of the tray. To this end, certain contacts move in unison with the tray and cooperate with fixed contacts to establish the electrical resistance for each tray position.

When a selection is made by the remote control handpiece and when the actuate switch is closed, a circuit is completed which energizes a motor in the projector thereby causing rotation of the tray. When the tray rotates such that the resistance of the elements within the projector equals the resistance established by selection of the desired slide at the control console, the projector and remote control resistances are balanced thereby de-energizing the motor and stopping the tray with the selected tray space positioned adjacent the projection gate. Again, reference should be had to my copending application for a detailed description of the random selection circuit.

FIG. 6 illustrates another embodiment of the present invention which may be used to define the arrangement of fixed and movable contacts within the slide projector. The contact arrangement illustrated in this figure permits the alternate use of a "100 slide tray" and an "80 slide tray", all more fully explained in my copending application identified above.

A member (not shown) on the projector and which is driven with the slide tray mounts four contact members 70, 71, 72 and 73 (only fingers 73a, 73h are illustrated) for movement therewith. A pair of fasteners (not shown) mounts these various contacts in a sandwich-type relation, the contacts being electrically insulated from each other by suitable dielectric washers. Contact member 70, which is a "tens" contact for the "80 slide tray," includes contact fingers 70a and 70b. Contact member 71, which is the "tens" contact for the "100 slide tray," includes contact fingers 71a and 71b. The contact member 72, which is the "units" contact for the "100 slide tray," includes ten equally spaced contact fingers 72a through 72j. Contact member 73, which is the "units" contact for the "80 slide tray," includes eight equally spaced contact fingers, only fingers 73a and 73h being shown.

All of the contact fingers just mentioned are in simultaneous wiping engagement with contact strips on a fixedly mounted contact plate 75. This contact plate includes a continuous annular contact strip 76; this strip is continuously wiped by the contact finger 71b. The plate 75 mounts ten contact strips 80 through 89. The outermost portions of the contact strips 80 through 87 and the two contact strips 88, 89, define ten contact areas, each of identical arcuate extent, which are arranged for one-at-a-time wiping engagement by the contact finger 71a.

Also mounted on the plate 75 in identical opposite hand relation is a pair of arcuate contact strips 90, 92. Each of these strips is always engaged by at least three of the contact fingers 72a through 72j. However, this is not critical, it being only necessary for one of the strips 90 or 92 to be engaged at all times by any one of these fingers. The contact board 75 mounts a first set of "units" contacts 100 through 104, and in diametrically opposed relation, a second set of "units" contacts 105 through 109. The innermost portions of the contacts 100 through 109 are arranged to be engaged by the contact fingers 72a through 72j; the outermost portions of these contacts are arranged to be engaged by the fingers 73a through 73h. The "units" contacts are arranged according to a vernier principle such that only one of the contacts 100 through 109 may be engaged at any one time by one of the fingers 72a through 72j or 73a through 73h. Assuming rotation of the contact member 72 in a clockwise direction as viewed in FIG. 5, the contacts 100 through 109 are engaged according to the following sequence: 100, 105, 101, 106, 102, 107, 103, 108, 104, 109.

A pair of identical contact strips 100, 111 is mounted on the plate 75 adjacent the periphery thereof. Each one of these contact strips is always engaged by three of the contact fingers 73a through 73h. However, this is not critical as it is only necessary for one of the contacts 110 or 111 to be engaged at all times by one of these contact fingers.

It is noted that the contact strips 80 through 87, at the innermost portions thereof, define eight contact segments or areas of equal arcuate extent (except for the inner arcuate portion of strip 80 as will be explained below); these contact areas may be considered as defining "tens" contacts for establishing 79 positions of the "80 slide tray" for numbers "01" through "79." The inner portion of contact 80 is slightly shorter than the corresponding portions of contacts 81 through 87; this inner portion of contact 80 defines positions or numbers "01" through "09". An innermost portion 88a of the contact 88 defines the "80" position of the "80 slide tray". These innermost portions of the contact strips 80 through 88 are arranged to be engaged one at a time by the contact finger 70a. The plate 75 is provided with a continuous annular contact strip 112 which is continuously wiped by the contact finger 70b.

It should be apparent there are one hundred different contact engagement positions considering the contact fingers 71a, 72a through 72j and the contact strips 80 through 89 and 100 through 109. This results since the contact finger 71a is arranged for one-at-a-time wiping engagement with ten of the "tens" contacts 80 through 89 and since each one of the ten contact fingers 72a through 72j will engage each of the ten "units" contacts 100 through 109. It will be understood that

each of these contact engaging positions establishes a predetermined electrical resistance corresponding to each of the one hundred spaces in the "100 slide tray". It will be appreciated that the arcuate spacing between the "units" contacts 100 through 109 is 3.6°, this being the result of 360° divided by one hundred, the total number of spaces in the "100 slide tray."

Considering the "80 slide tray," the contact finger 70a is arranged for one-at-a-time wiping engagement with the "tens" contact strips 80 through 88. There are eight of the contact fingers 73a through 73h; during a complete rotation of the contact 73, each of the eight fingers thereof will engage, in one-at-a-time relation, the outermost portions of the contact strips 100 through 109. This arrangement of contact strips just described will provide eighty different predetermined electrical resistances corresponding to the eighty spaces in the "80 slide tray." Accordingly, the arcuate spacing between the outermost portions of the contact strips 100 through 109 is 4.5°, this being the result of 360° divided by 80. It will be noted that the contact strip 89 is not used when the projector is associated with the "80 slide tray."

Reference should be had to the parent application for a complete description of the circuitry associated with the arrangement of fixed and movable contacts just described. It is sufficient to state herein that when the contact 72 is switched into the circuit, one hundred predetermined electrical resistances may be established corresponding respectively to the spaces in a "100 slide tray." When the contact 72 is switched out and the contact 73 switched in, eighty predetermined electrical resistances may be established corresponding respectively to the spaces in an "80 slide tray."

It should be understood that in lieu of the contact arrangement shown in FIG. 6, a contact arrangement identical to that shown in FIGS. 2 and 3 may be incorporated within the slide projector. Also, it will be understood by those skilled in the art that the contact arrangement shown in FIG. 6 is suitable for incorporation in a remote control handpiece in association with a selector knob and indicia for indicating the selected slide space.

The remote input or control console 10 shown and described herein is adapted only for use with a "100 slide tray." However, it will be understood that such console may be readily adapted for use with trays having other than one hundred slide receiving spaces, such as the "80 slide tray" mentioned herein. In the case of the "80 slide tray," suitable switching may be provided to prevent actuation of the circuit when any number from "81" through "99" is selected when such tray is in use. Such switching is shown and described in my co-pending application.

I claim:

1. A rotary switching device to set up a separate contact condition representing each of a plurality of object positions in a transportable object holder of a random selection slide projector or the like comprising:

- a. an array of "tens" contact formations arranged to define an annular pattern and each representing a series of ten object positions;
- b. a set of at least ten "units" contact formations arranged to lie on an imaginary circle concentric with said annular pattern, and each representing an indi-

vidual object position within each series of ten positions;

- c. first contact means having a first contact finger arranged for one at a time wiping engagement with said "tens" contact formations;
- d. second contact means having a plurality of second contact fingers, the number of which when multiplied by the number of "units" contact formations equals the product of ten times the number of "tens" contact formations, said second contact fingers being arranged such that only one thereof engages only one of said "units" contact formations at any one time, and also such that each of said contact fingers engages each of said "units" contact formations during a switching cycle defined by said first contact finger engaging each of said "tens" contact formations;
- e. means mounting said "tens" and "units" contact formations in a fixed relationship with respect to each other; and
- f. rotatable hub means for mounting said first and second contact means in a fixed relationship with respect to each other for rotational movement relative to said "tens" and "units" contact formations, to establish an individual contact condition for each of said "tens" and "units" contact formations engaged by said first and second contact means, respectively.

2. The switching device according to claim 1 wherein said "tens" contact formations are equal in number to the number of "units" contact formations and wherein the former are integral with the latter, respectively.

3. The switching device according to claim 2 further defined by:

- a. said second contact means being defined by ten radially extending, equally spaced fingers; the distal ends of which are generally coplanar;
- b. said "tens" contact formations being defined by segments of a circle, such formations being of equal arcuate extent; and
- c. said "units" contact formations being spaced from each other to define nine equal chords of such imaginary circle and one chord substantially shorter than one of said equal chords.

4. The switching device according to claim 1 further defined by:

- a. said second contact means being defined by ten radially extending, equally spaced fingers, the distal ends of which are generally coplanar; and
- b. said "units" contact formations being ten in number and spaced from each other to define nine equal chords of said imaginary circle and one chord substantially shorter than one of said equal chords.

5. The switching device according to claim 4 wherein said "tens" contact formations are ten in number and are integral with respective "units" contact formations.

6. The switching device according to claim 5 wherein at least one other contact formation is arranged between two of said "units" contact formations and has an arcuate extent such that it is always engaged by one of said second contact fingers when any of said "units" contact formations is engaged by any one of the other of said second contacts.

7. The switching device according to claim 1 further defined by:

- a. circuit means defining a random selection circuit for a slide projector; and
- b. said circuit means including a plurality of resistance elements arranged in series relationship by respective elements being connected between adjacent ones of said "tens" contact formations. 5
- 8. The switching device according to claim 7 further defined by:
 - a. said second contact means being defined by ten radially extending, equally spaced fingers, the distal ends of which are generally coplanar; 10
 - b. said "units" contact formations being ten in number and spaced from each other to define nine equal chords of said imaginary circle and one chord substantially shorter than one of said equal chords; and 15
 - c. said "tens" contact formations being ten in number and being integral with respective "units" contact formations.
- 9. A switching device according to claim 1 wherein said second contact fingers of said second contact means are equally spaced, radially extending and have distal ends which are generally coplanar. 20
- 10. A switching device according to claim 1 wherein said hub means includes a disc having a plurality of numerals thereon, each corresponding to an object position. 25
- 11. A switching device according to claim 10 further comprising peripheral indexing teeth on said disc; and manually operable indexing pawl means adapted to engage the peripheral indexing teeth to advance the disc from one numeral to the next. 30
- 12. A switching device according to claim 10 wherein said hub means includes a knob to permit manual rotation. 35
- 13. A switching device according to claim 1 wherein said hub means is disposed in operative connection with a rotary object holder for rotational movement therewith.
- 14. A rotary switching device according to claim 1 further including means to set up separate contact conditions representing each of a plurality of object positions in first and second alternate transportable object

holders having different numbers of positions, said means comprising:

- a. a second array of "tens" contact formations different in number from said first stated array of "tens" contact formations and arranged to define an annular pattern, wherein each of said second "tens" contact formations represents a series of ten object positions in said second object holder;
- b. a second set of at least ten "units" contact formations arranged to lie on an imaginary circle concentric with said first stated set of "units" contact formations and spaced from each other a greater distance than adjacent ones of said first stated set, wherein each of said second "units" contact formations represents an individual object position within each series of ten object positions represented by each of said second "tens" contact formations;
- c. third contact means having a third contact finger mounted on said hub means and arranged for one at a time wiping engagement with said second array of "tens" contact formations; and
- d. fourth contact means mounted on said hub in a fixed relationship with said third contact means and having a plurality of fourth contact fingers the number of which when multiplied by the number of "unit" contact formations in said second set equals the product of ten times the number of "tens" contact formations in said second array, said fourth contact fingers being arranged such that only one thereof engages only one of said second "units" contact formations at any one time, and also such that each of said fourth contact fingers engages each of said second "units" contact formation during a second switching cycle defined by said third contact finger engaging each of said second "tens" contact formations.
- 15. A switching device according to claim 14, further comprising a plurality of contact plates having first portions which define said first stated array of "tens" contact formations and second portions which define said second array of "tens" contact formations.

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