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PATENT SPECIFICATION

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DRAWINGS ATTACHED

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(54) IMPROVEMENTS IN OR RELATING TO SLIDE PROJECTORS

(71) We, GAF CORPORATION, a corporation organised under the laws of the State of Delaware, United States of America, of 140 West 51st Street, City, County and State of New York, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to slide projectors and, in particular, to an improved random selection system for slide projectors.

Heretofore, slide projectors intended for use by amateurs have been adapted to show slides only in a consecutive manner. Such projectors may include either box-like slide trays or circular slide trays. The trays are advanced in forward or reverse directions for projecting the slides in the sequence determined by their location in the slide tray. The present invention has to do with inexpensive and relatively uncomplicated means whereby any slide selected at random may be projected, thereby permitting the user to project slides in any order or sequence.

It is an advantage of the present invention that it provides a random selection system wherein the slide tray will always move the minimum distance for presenting the selected space adjacent the projection gate or station, and wherein the projector is adapted alternatively to accommodate two slide trays, each tray having a plurality of uniformly spaced slide spaces, the trays differing from each other in the interval or spacing between adjacent slide receiving spaces.

The present invention will now be illustrated with reference to the accompanying drawings, in which:—

Fig. 1 is a perspective view of a slide projector embodying the present invention;

Fig. 2 is an enlarged perspective view of the underside of a cap member mounted on a central hub of the projector;

Fig. 3 is a perspective view of the slide projector hub with the cap of Fig. 2 removed;

Fig. 4 is an exploded perspective view showing certain parts of the hub on the slide projector;

Fig. 5 is an enlarged top plan view of an arrangement of contacts for the "100 slide tray" shown in Fig. 1;

Fig. 6 is a view similar to Fig. 5 and showing the arrangement of contacts for an "80 slide tray";

Fig. 7 is a vertical section taken through the central hub of the slide projector;

Fig. 8 is an exploded perspective view of the remote control handpiece associated with the projector;

Fig. 9 is a side elevational view of an internal subassembly of the remote control handpiece;

Fig. 10 is an electrical schematic of the "tens" contacts and associated resistor network;

Fig. 11 is an electrical schematic of the "units" contacts and associated resistor network;

Fig. 12 is an electrical schematic of the components within the remote control handpiece; and

Fig. 13 is an electrical schematic of the components within the slide projector.

Referring to Fig. 1 the slide projector, generally designated 10, includes a housing or casing 12 rotably supporting a circular slide tray, generally designated 14. For purposes of illustration, it is to be assumed that the tray 14, hereinafter sometimes referred to as the "100 slide tray", includes one hundred radially disposed, slide receiving spaces. The

slide projector includes suitable means for lowering a slide from the tray 14 to a projection gate or station and for lifting and returning such slide to its space in the tray.

5 The slide projector 10 may be of the type disclosed and claimed in Patent Specification No. 1,234,999. The only essential difference between the projector shown in this specification and the projector 10 resides in the indexing mechanism, i.e., the mechanism for stepping or advancing the slide tray. The indexing mechanism according to Patent Specification No. 1,234,999 advances the slide tray a distance represented by one tray space for each slide charging cycle. No such indexing mechanism need be provided with the projector 10 as the random selection system according to the present invention includes as an integral part thereof suitable indexing means for advancing the tray to present at the slide projection gate any slide space selected at random. It will be understood that the present invention is adapted for use with any particular type of slide projector.

20 The circular slide tray 14 includes inner and outer continuous walls 15 and 16 supporting therebetween one hundred radially extending partition members 18 defining one hundred slide receiving spaces. The slide tray may be of the type disclosed in the aforementioned copending application.

25 At this time it should be mentioned that the projector 10 is adapted to receive alternately the 100 slide tray 14 and another tray (not shown) identical in all respects with the tray 14 except for the number of slide receiving spaces. Such other tray, hereinafter referred to as the "80 slide tray", has 30 eighty spaces, the partitions being spread or spaced farther apart than the partitions in the tray 14 to accommodate glass mounted slides. Such slides are thicker than cardboard slides which are received in the spaces 19 of the tray 14.

35 Referring now particularly to Figs. 2, 3, 4 and 7, the projector 10 includes a central stationary hub defined by an annular wall 22. This wall defines a chamber or space 23 mounting a reversible electric motor 24; this motor is mounted eccentrically of or to one side of a central shaft 25. The motor 24 includes a suitable gear in meshing engagement with a gear 27 mounted on a pin 28, the latter being suitably journaled adjacent its respective opposite ends. The pin 28 mounts a pinion gear 30 in meshing engagement with a larger gear 31; the gear 31 is mounted for rotation about the pin 25. As noted in 40 Fig. 3, the gear 31 includes an upwardly facing series of clutch teeth 33; these teeth are in releasable meshing engagement with identical teeth 34 integral with a cap or disk member 35. The cap 35 is held in place by a member 37, the latter being connected to the

upper end of the post 25 by suitable means.

It will be appreciated that energization of the motor 24, which is of the reversible type, will impart corresponding rotation to the member 35. The cap 35 includes a radially extending tab 38 (Fig. 1) which is received within a notch in the tray 14; this provides a driving connection whereby rotation is imparted to the tray 14 from the member 35. The releasable or slippable clutch teeth 33, 34 prevent damage to the drive train components in the event of energization of the circuit at a time when the tray is unable to move due to restraining force being applied thereto, as for example, by a slide jammed between the projection gate and a space in the tray.

As noted in Fig. 2, the cap 35 mounts four contact members 40, 41, 42 and 43 for movement therewith. A pair of fasteners 45 mount these various contacts in a sandwich-type relation, the contacts being electrically isolated from each other by dielectric washers, such as the washer 46. Contact member 40, which is a "tens" contact for the "80 slide tray", includes contact fingers 40a and 40b. Contact member 41, which is the "tens" contact for the "100 slide tray", i.e., the tray 14, includes contact fingers 41a and 41b. The contact member 42, which is the "units" contact for the "100 slide tray", includes ten equally spaced contact fingers 42a. Contact member 43, which is the "units" contact for the "80 slide tray", includes ten equally spaced contact fingers 43a.

All of the contact fingers just mentioned are in simultaneous wiping engagement with contact strips on a fixedly mounted contact plate 50. This contact plate is best illustrated in Figs. 3, 5 and 6. It will be understood that in Fig. 5 only the movable contacts for the "100 slide tray" are shown, i.e., movable contacts 41 and 42. In Fig. 6, only the movable contacts for the "80 slide tray" are shown, i.e., contacts 40 and 43.

Referring to Figs. 3 and 5, it will be seen that the contact plate 50 includes a continuous annular contact strip 52; this strip is continuously wiped by the contact finger 41b. The plate 50 mounts ten contact strips 54 through 63. The outermost portions of the contact strips 54-61 and the two contact strips 62, 63, define ten contact areas, each of identical arcuate extent, which are arranged for one-at-a-time wiping engagement by the contact finger 41a.

Also mounted on the plate 50 in identical opposite hand relation are a pair of arcuate contact strips 65, 66. Each of these strips is always engaged by at least three of the contact fingers 42a. However, this is not critical, it being only necessary for one of the strips 65 or 66 to be engaged at all times by any one of the fingers 42a.

The contact board 50 mounts a first set

of "units" contacts 70 through 74, and in diametrically opposed relation, a second set of "units" contacts 75 through 79. These contacts are uniformly spaced apart and arranged to be engaged by the contact fingers 42a. The contacts 70—79 are arranged according to a vernier principle such that only one of these contacts may be engaged at any one time with one of the fingers 42a. Assuming rotation of the contact member 42 in a clockwise direction as viewed in Fig. 5, the contacts 70—79 are engaged according to the following sequence: 70, 75, 71, 76, 72, 77, 73, 78, 74, 79.

Turning now to Fig. 6, the contact plate 50 will be seen to include a first set of "units" contacts 80—84 and a second set of "units" contacts 85—89; the contacts 80—89 are preferably integral with the contacts 70—79, respectively. The contacts 80—89 are uniformly spaced apart and arranged for being engaged by the contact fingers 43a. The contacts 80—89 are arranged to a vernier principle whereby only one of the contacts 80—89 will be engaged at any one time by only one of the fingers 43a. Assuming clockwise rotation of the contact 43 as viewed in Fig. 6, the sequence of engagement of the contacts 80—89 is as follows: 80, 85, 81, 86, 82, 87, 83, 88, 84, 89.

A pair of identical contact strips 91, 92 are mounted on the plate 50 adjacent the periphery thereof. Each one of these contact strips is always engaged by three of the contact fingers 43a. However, this is not critical as it is only necessary for one of the contacts 91 or 92 to be engaged at all times by one of the fingers 43a.

It is noted that the contact strips 54—61, at the innermost portions thereof, define eight contact segments or areas of equal arcuate extent (except for the inner arcuate portion of strip 54 as will be explained below); these contact areas may be considered as defining "tens" contacts, for establishing seventy nine positions of the "80 slide tray" for numbers "01" through "79". The inner portion of contact 54 is slightly shorter than the corresponding portions of contacts 55—61; this inner portion of contact 54 defines positions or numbers "01" through "09". An innermost portion 62a of the contact 62 defines the "80" position of the "80" slide tray. These innermost portions of the contact strips 54—62 are arranged to be engaged one-at-a-time by the contact finger 40a. The plate 50 is provided with a continuous annular contact strip 93 which is continuously wiped by the contact finger 40b.

Referring to Fig. 5, it should be apparent there are one hundred different contact engagement positions considering the contact fingers 41a, 42a and the contact strips 54—63 and 70—79. This results since the con-

tact finger 41a is arranged for one-at-a-time wiping engagement with ten of the "tens" contacts 54—63 and since each one of the ten contact fingers 42a will engage each of the ten "units" contacts 70—79. As will be apparent from Figs. 10 and 11, each of these contact engaging positions establishes a predetermined electrical resistance corresponding to each of the one hundred spaces in the slide tray 14. These one hundred different predetermined electrical resistances are established by arrangements of "tens" resistors 95a—95i and "units" resistors 96a—96i connection to the various contact strips just mentioned as shown in Figs. 10 and 11. It will be apparent that as the contacts 41, 42 rotate clockwise, additional resistors are included in series in the circuit. Preferably, the "tens" resistors are of equal value and the "units" resistors are also of equal value, but this is not necessary. It should be understood that a parallel resistor network could be used with such resistors being of progressively increasing or decreasing value.

As noted in Fig. 4, the fixed resistors 95, 96 may be mounted on the underside of the plate 50. The contacts 41, 42 move in unison with the tray 14 during rotation thereof. It will therefore be appreciated that the arcuate spacing between the "units" contacts 70—79 is 3.6° , this being the result of 360° divided by one hundred, the total number of spaces in the circular slide tray 14.

As explained above, the contact arrangement for the "80 slide tray" is shown in Fig. 6. The contact finger 40a is arranged for one-at-a-time wiping engagement with the "tens" contact strips 54—62. There are eight of the contact fingers 43a, during a complete rotation of the contact 43, each of the eight fingers 43a will engage, in one-at-a-time relation, the contact strips 80—89. 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 contact strips 80—89 is 4.5° , this being the result of 360° divided by eighty. It will be noted the contact strip 63 and the resistor 95i connected thereto are not used when the projector is associated with the "80 slide tray".

Referring now to Figs. 1, 8 and 9, a remote control handpiece, generally designated 100, is connected to the slide projector 10 by a suitable length of multi-conductor cable 101. Preferably, the cable 101 is connected with a plug 102 for detachable engagement with a jack 103 on the projector. The handpiece includes two shell members 105, 106 which house a subassembly, generally designated 107. The subassembly includes a pair of plates 108, 109, each being formed of dielectric material.

The plate 108 rotatably mounts a "units" selector wheel 110 having peripherally arranged formations 110a to facilitate manual rotation thereof, as from engagement by the operator's thumb. The shell 106 includes an opening 111 through which a portion of the selector wheel 110 extends for being manually rotated. Mounted for rotation with the selector wheel 110 is a cylinder 114 bearing the numerals "1" through "9" and "0". These numbers are visible one at a time through a window 115 in the shell piece 106. The selector wheel 110 mounts a contact (shown schematically as 145 in Fig. 12) for one-at-a-time engagement with an arrangement of ten contact strips 116—126, mounted in insulated relation with each other on the plate 108. The contact strips 116—126 are connected with a series arrangement of resistors 127a through 127i so that ten different resistances are established during a complete rotation of the selector wheel 110. The values of these resistors are such that the resistance will be varied in a progressive manner from a minimum value to a maximum value during a complete rotation of the selector 110. In effect the arrangement just described defines a variable resistor of the rotary type.

The plate 109 rotatably mounts a "tens" selector wheel 130 having peripherally arranged notches 130a to facilitate manual rotation. This selector wheel rotates a cylinder 132 identical with the cylinder 114 and bearing the same numerical indicia as the latter. Also mounted for rotation with the selector wheel 130 is a detent wheel 134 having radially disposed fingers for being engaged by a spring biased detent finger 136, the latter being suitably secured in the shell piece 105. An identical spring biased detent finger 137 engages a detent wheel (not shown) mounted for movement with the selector wheel 110.

The "tens" selector wheel 130 carries a contact (schematically indicated as 148 in Fig. 12) for movement with respect to an arrangement of contact strips identical, but in opposite hand relation, to the strips 116—126, these strips being mounted on the other side of the plate 107 and being connected with a series arrangement of resistors 128a through 128i (Fig. 12). Rotation of the selector wheel 130 through a complete revolution will establish ten predetermined resistances in a progressive manner from a minimum value to a maximum value.

The subassembly 107 mounts an initiate button 138 having a cross rib 139 which is received within a window or opening 140 formed in the shell piece 106. This button controls two sets of contacts for initiating a cycle of operation as will be explained below. Spring means (not shown) urge the button to an open position wherein such contacts are opened.

Turning now to Fig. 12, which is an electrical schematic of the remote control handpiece 100, the "units" selector wheel 110 carries the contact 145 which engages in one-at-a-time relation the various contact strip 116—126 on the plate 107, these contact strips being connected to the various resistors 127a—127i. In like manner, the "tens" selector wheel 130 carries the contact 148 for one-at-a-time engagement with the various contact strips (not shown) on the plate 107, such contact strips being connected to the resistors 128a—128i in series relation.

A movable contact 150 is moved in unison with the contact 148 through a suitable mechanical connection, including a pair of gears or friction rollers 151, 152. Spring means are provided for normally holding the contact 150 in the position illustrated wherein the same is in engagement with a fixed contact 154. When the contact 150 is moved in a counterclockwise direction, it separates from the fixed contact 154 and comes into engagement with an arcuate fixed contact strip 155. The initiate button 138 is connected with the friction wheels 151, 152, in such manner that when the initiate button is actuated, the wheels 151, 152 will be separated allowing the aforementioned spring means to return the contact 150 to the position illustrated, i.e., into engagement with the fixed contact 154.

The "units" selector wheel 110 also carries a contact 157; this movable contact engages a stationary contact 158 only when the selector wheel 110 is positioned for locating "0" in the window 115. The contact 157 is in engagement with a contact strip 159 at any position of the selector wheel 110 between "1" and "9". Similarly, the "tens" selector wheel 130 carries a contact 160; this contact is arranged to engage an arcuate contact 161 as the selector wheel 130 is rotated to any position between "1" and "9". It is noted that the contact 160 will engage short fixed contacts 162 and 163 when the selector wheel 130 is rotated to position numerals "8" and "0", respectively within the window 115. A dead contact is pivoted at "9".

An "80—100" selector button 142, which is mounted on the projector (Fig. 1), operates a contact 164 for alternate engagement with a pair of fixed contacts 165, 166, representing respectively the "100" and "80" positions of the selector button 142. The initiate switch 138 operates a pair of contacts 168, 169 for momentary engagement with respective fixed contacts 170, 171, suitable spring means (not shown) being provided for urging the button 138 and the contacts moved thereby to the open position illustrated.

As will become apparent herein, operation of the initiate button 138 closes the circuit for initiating a cycle of operation. The mov-

able contacts 157 and 160 are provided to prevent closing of the circuit by the initiate button when the selector button 142 is in the "80" position, i.e., when the contact 164 is in engagement with the contact 166, and when any number from "81" to "100" is dialed or established by the selector wheels 110, 130. It should be apparent that when the selector button 142 is in this position and when any such number is selected, it will not be able to close the circuit notwithstanding actuation of the initiate button.

For example, it should be possible to close the circuit when the selector wheels 110, 130 are positioned as shown in Fig. 12, i.e., for selecting number "12". In this case, the circuit may be traced as follows: terminal 166, switch contacts 171, 169, contact 160 and terminal 172. In this particular example, the contact 157 serves no function.

Now assume that the "tens" selector wheel 130 is moved to establish number "82". In this case, the contact 160 will be in the broken line illustrated. The circuit will now be as follows: terminal 166, switch contacts 170, 169, contacts 160, 158; hence, the circuit is not completed as contact 158 is not engaged by the contact 157. On the other hand, if the "units" selector 110 is moved to select "80", in which case contact 157 will be in the broken line position shown, the circuit will be complete through terminal 172. As soon as the selector wheel 110 is moved to establish a larger number, such as "81", it will be seen that it is not possible to complete the circuit.

Referring to Fig. 13, which is an electrical schematic of the circuit within the projector 10, it will be understood such circuit is connected to the circuit within the remote control handpiece 100 by suitable connection at the terminals 165, 166, 172, 173, 188 and 218. In other words, a six conductor cable or cord connects the handpiece with the projector.

The circuitry within the projector is of the balancing resistance type. That is to say, the circuit will cause energization of the motor 24 when the electrical resistance established in the remote control handpiece is different than the resistance established by the variable resistors within the projector. When these resistances are equal or in a balanced condition, the motor will be de-energized. To facilitate understanding the operation of the present invention, a simplified form of "units" contacts has been schematically illustrated in Fig. 13. As noted, one movable contact 42a for the "100 slide tray" 14 has been shown, and likewise one movable contact 43a for the "80 slide tray" has been shown. With such an arrangement, the "units" contact 42a may be driven by a suitable gearing arrangement 175 at a 10:1 ratio with the "tens" contact 41a. Similarly,

the contact 43a is driven by an appropriate gearing arrangement 176 at a 10:1 ratio with the movable contact 40a. The gearing arrangements 175, 176 are each driven by the motor 24. It will be appreciated this construction will provide the same switching arrangement as is achieved by the vernier type of "units" contacts illustrated in Figs. 5 and 6; the arrangement according to these two figures is preferred as it obviates the use of the drive gear arrangements 175, 176.

The selector button 142 also controls a pair of switches 177, 178; these switches are shown in the "100" position. Power for the circuit is obtained from a transformer 180, which may be constituted by the secondary windings of a fan motor (not shown) included within the slide projector 10 and energized by alternating current.

The motor 24 is controlled primarily by a transistor 181 (NPN) and a relay 182. Another transistor 183 (PNP) and an associated relay 184 participate to reverse the motor 24 for achieving what is termed a "short-way home operation"; this feature will be described hereinbelow.

In describing the operation of the circuit, the variable resistor networks controlled by the "tens" and "units" selector wheels in the remote control handpiece will be referred to as Tr and Ur, respectively. Similarly, the "tens" and "units" variable resistor networks within the projector will be identified as T and U, respectively. Ur and U form a series circuit with the power transformer 180, which is an A.C. power source for the circuit. Point 185 of the transformer is set at half the voltage between points 186 and 187. Point 188 will also be at one half the voltage of points 186 and 187 if the resistance of Ur is equal to the resistance of U, since Ur and U represent a voltage dividing network.

Assume now that selector wheel 110 is moved to establish a lower "units" number; this will move contact 145 in a counterclockwise direction decreasing the resistance of Ur with respect to U. Assuming point 187 is negative with respect to point 186, point 188 will also be negative with respect to point 185. This will provide a negative signal to the base of transistor 183 (PNP) through the diode 217, thus switching transistor 183 into an "on" state. Transistor 183 controls the relay 184; when the former is triggered into conduction, the latter will be energized. When the relay 184 is energized the four movable contacts thereof (shown by the arrows) will simultaneously shift from contacts 206, 209, 212 and 215 to contacts 205, 208, 211 and 214, respectively. A circuit will now be established as follows: point 185, transistor 183, relay contacts 197, 195 (the relay 182 is still in the de-energized position as illustrated), relay coil 184a, diode 219 and terminal 187.

It will be apparent that alternating current is presented at points 225, 226. By reason of the diode 227, line 228 is positive and line 229 is negative. Therefore, when the relay 184 is energized for bringing contact 204—205 and 207—208, it will be apparent that the polarity of the power source for energizing the motor 24 will be reversed. In other words, contacts 205 and 209 are positive and contacts 206 and 208 are negative. Thus, when the relay 184 is in a de-energized state, contact 207 is positive and contact 204 is negative. In the energized state of relay 184, contact 207 is negative and contact 204 is positive.

Continuing with the example under consideration, when the initiate button 138 is momentarily depressed, contacts 168, 170 are closed for providing a positive voltage to the collector of transistor 181. At this time it should be mentioned, that during the instant when point 187 is positive with respect to point 186, the point 188 will also be positive with respect to point 185. Under these conditions, the transistor 181 will be biased "on". Transistor 181 controls the relay 182; when the former is triggered into conduction the latter is energized.

With the transistor 181 turned "on" and the relay 182 energized, a circuit is established as follows: point 185, transistor 181, relay coil 182a, contacts 164, 165, contacts 170, 168 and to terminal 230. After the relay 182 is energized, the contacts 170, 168 controlled by the initiate button and the contacts 164, 165 controlled by the selector button 142 will be shunted or bypassed by the contacts 201, 202 of the energized relay 182. Diodes 231, 232 are holding diodes which prevent de-energizing of the relays 182, 184 during the momentary "off" state of the transistors 181, 183. This momentary "off" condition of the transistors is due to the alternating current base signal.

Energizing of the relay 182 will also serve to "lock" the relay 184 in its energizing state by-passing the transistor 183. This circuit is as follows: point 187, diode 219, relay coil 184a, contacts 195, 196 of relay 182, contacts 214, 213 of relay 184 and point 185. Also, relay 182 will close the circuit to the motor 24 for energizing the latter as follows: point 186, resistor 234, diode 227, contacts 205, 204 of relay 184, contacts 193, 192 of relay 182, motor 24, contacts 207, 208 of relay 184, point 187. This condition (that is, energization of the motor 24) will exist as long as transistor 181 is in the "on" state.

When U equals U_R , point 188 is zero with respect to point 185 and the transistor 181 will be turned off, thereby de-energizing relay 182. Now, contacts 192, 193 will be opened, de-energizing the motor 24. Simultaneously, contacts 192, 194 will close, short-circuiting the motor 24. This serves as a "dynamic

brake" for the motor ensuring positive stopping thereof. De-energizing of relay 182 will also open contacts 195, 196 and make contact between contacts 195, 197. Since transistor 183 will also be in an "off" condition, the relay 184 will of course also be de-energized.

The tray will now have been rotated to position the selected slide adjacent the projection gate of the projector. This completes a cycle of operation in the example just described.

Now, assume that the "units" selector wheel 110 is rotated in the opposite (clockwise) direction to select a greater "units" number. This will result in contact 145 being moved in a clockwise direction thereby resulting in U_R being greater than U . When point 187 is negative with respect to point 186, point 188 will be positive with respect to point 185. Now, momentary operation of the initiate button will close the contacts 168, 170 turning transistor 181 "on" and energizing relay 182. The circuit to the motor will be as follows: point 186, resistor 234, diode 227, contacts 209, 207 of the relay 184 (which is not energized during this example), motor 24, contacts 192, 193 of the energized relay 182, contacts 204, 206 of the de-energized relay 184, and then to point 187. As just mentioned, the relay 184, which is controlled by the transistor 183, is not energized. It should be apparent that the transistor 183 can be turned "on" only when point 187 is negative because of diode 219.

In the example under consideration, the contact 42a and the tray will again be rotated, but in an opposite or clockwise direction until the resistances U_R-U are balanced.

It should be appreciated that an unbalanced condition between Tr and T will energize the circuit in the same manner as just described. Movement of both the "tens" and "units" selector wheels 130 and 110 also establishes an unbalanced condition to energize the circuit and rotate the tray as well as contacts 41a and 42a until a balanced resistance condition is reestablished thereby to de-energize the motor.

Since the resistive values of $Tr-T$ and U_R-U networks are similar, it is necessary to use the diodes 190, 190a in order to discriminate between respective balances established by U_R and U on the one hand and Tr and T on the other hand. For example, without these diodes, a balance condition would exist when:

$$\begin{array}{ccc} Tr=T & & Tr=U \\ & \text{or (and)} & \\ Ur=U & & Ur=T \end{array}$$

As mentioned above, the transistor 183 and the relay 184 come into play to provide a

short-way home feature. By this is meant that the motor will always be energized to rotate the tray through the minimum amount of distance to present the selected space adjacent the projection gate. Or in other words, with this feature, the tray will never rotate more than approximately 180° .

This short-way home feature will first be described assuming that only a change in the "units" selection is made. Assume that the slide tray 14 has the spaces therein numbered from "01" to "100" proceeding in a counterclockwise direction as viewed looking down on such tray. Whenever the "units" selector wheel is rotated to select a higher "units" number, it is clear the tray should rotate in a clockwise direction to present the selected space at the projection gate with a minimum amount of tray travel. Likewise, it is clear that if the "units" selector is moved to select a lower "units" number the tray should rotate in the opposite direction, i.e., a counterclockwise direction. When a greater "units" selection is made, the resistance of U is greater than U and whenever a lower "units" selection is made, the resistance of U is greater than Ur.

Referring again to the circuit shown in Fig. 13, it should be understood that the transistor 181 and associated relay 182 serve to complete a circuit for energizing the motor 24. In contrast, the transistor 183 and associated relay 184 act to determine in which direction the motor 24 turns. The invention is not to be limited to the particular arrangement shown. That is to say, the transistor 183 and associated relay 184 might come into play during the "forward" direction, and only the transistor 181 and associated relay 182 coming into play during the "reverse" operation.

The short-way home feature has just been described when moving the "units" selector wheel 110. Now, the short-way home feature will be described in connection with movement of the "tens" selector wheel 130.

It is clear that if the "tens" selector 130 is moved to select a higher number, say from "05" to "15", the tray should rotate in a clockwise direction. However, if the "tens" selector is moved to select a higher number, say "95", when the previous selection was "05", the tray should now rotate in a counterclockwise direction. In other words, in distinction to operation of the "units" selector, when the "tens" selector is moved, the direction of rotation of the tray is not necessarily a function of whether the new selection is a higher number than the previous selection, but rather what positional relationship, proceeding either clockwise or counterclockwise around the tray, the selected space bears with respect to the previously selected space. Regardless of the selection made, whether by movement of the "tens" selector alone or by

movement of both the "tens" and "units" selectors, the tray should of course never rotate more than approximately 180° . At this time it should be mentioned that when the selected space is in diametrically oppositely disposed relation with the previously selected space, e.g., "55" from "05", the circuit is simply designed by selecting appropriate values of the components so that the tray will rotate in one direction arbitrarily chosen.

As mentioned above, the selector wheel 130 controls the movable contact 150 of the mono-stable switch. Assuming that the "tens" selector 130 is rotated from "12" to select "22", contact 150 is rotated in a clockwise direction thus adding the resistance of fixed resistor 222 to Ur so that the combined value of resistor 222 and Ur will always be greater than the resistance value of U. This will result in maintaining transistor 183 in a "off" condition. When the initiate button 138 is actuated transistor 181 will be biased on energizing relay 182 and motor 24 provides for rotation of the tray in its normal clockwise direction. Of course, as soon as the initiate button 138 is actuated, the friction wheels or gears 151, 152 are disengaged, allowing the contact 150 to swing back to its position shown. After electrical contact is established by closing contacts 168 and 170, relay 184 will remain locked in the position shown (de-energized) for the remaining search cycle. When contact 150 returns to its position shown, i.e., into engagement with contact 154, the resistor 222 is shunted.

Now, if selector wheel 130 is rotated in the opposite direction, the contact 150 will rotate counterclockwise thus shunting Ur by the value of resistor 223. Accordingly, the combined value of Ur and resistor 223 will always be less than the resistance value of U. Therefore, as soon as contact 150 is moved in a counterclockwise direction, the transistor 183 will be biased on energizing the relay 184 for reversing the direction of the motor as explained above in the description of the "units" operation. When the initiate button 138 is actuated, the relay 182 will be energized at the same time locking the relay 184 in its reversing position. This actuation of the initiated button will of course disengage the friction rollers 151, 152, allowing the contact 150 to return to its position illustrated. It is seen that clockwise rotation of contact 150 up to fifty slides (180°) will not reverse the polarity of the motor regardless of the setting. On the other hand, angular positioning of 150 between 180° and 360° will reverse the motor regardless of the resistance value in Ur.

It should be apparent that the operation of the circuit is the same when the selector member 142 is moved to the "eighty" position. As explained above, when the selector is in this position, it is not possible to

energize the circuit when a number between "81" and "100" is selected. Or in other words, when the selector switch 142 is in the "eighty" position, it is only possible to energize the circuit when tray spaces "01" through "80" are selected. When the selector switch 142 is in the "100" position, it is possible to select any of the spaces between "01" and "100".

10 WHAT WE CLAIM IS:—

1. A projector of the type having a projection gate and an associated tray with a plurality of spaces therein for receiving respective transparencies to be projected, comprising means for advancing said tray to present adjacent such gate any of said tray spaces selected at random said means comprising: (a) input means for selecting any of the spaces in said tray; (b) first variable resistance means operated by said input means for establishing a predetermined electrical resistance for each selection made by the input means; (c) an electric motor for advancing said tray; (d) second variable resistance means operated by said motor simultaneously with movement of said tray thereby, said variable resistance means serving to establish a predetermined electrical resistance for each position of said tray as defined by the spaces therein being presented one at a time adjacent said gate; and (e) circuit means connecting said motor and said first and second variable resistance means and adapted to energize said motor when the respective resistances established by said first and second variable resistance means are in a first relationship with respect to each other and to de-energize said motor when the respective resistances established by said first and second variable resistance means are in a second relationship with respect to each other.

2. The projector according to Claim 1 further defined by:

(a) said input means including a "tens" selector and a "units" selector for selecting any number between unity and a maximum number;

(b) said first variable resistance means including a pair of variable resistors operated respectively by said "tens" and "units" selectors;

(c) said second variable resistance means including another pair of variable resistors; and

(d) means driven by said motor simultaneously with movement of said tray thereby to vary the resistances of said another pair of variable resistors at a ratio of 10:1 with respect to each other.

3. The projector according to Claim 2 wherein said means driven by said motor includes fixed and movable "tens" contacts and fixed and movable "units" contacts, the latter being arranged in a vernier relationship with

each other, said movable contacts being moved by said means driven by said motor.

4. The projector according to Claim 3 further defined by:

(a) said fixed "tens" contacts being in the form of a plurality of segments arranged in a continuous annular pattern;

(b) said movable "tens" contacts being a single contact arranged to engage said segments one at a time in seriatim;

(c) said fixed "units" contacts being spaced from each other according to an arcuate pattern such that all of the fixed "units" contacts considered together define a segment the arcuate extent of which is equal to one of said fixed "tens" contact segments; and

(d) said movable "units" contacts being defined by a plurality of contact fingers, said fingers and said fixed "units" contacts being arranged such that only one of the latter may at any one time be engaged by anyone of the former.

5. The projector according to Claim 1 wherein means are provided for advancing said tray the minimum distance to present the selected tray space adjacent the projection gate, said means comprising:

(a) said circuit means including a reversing circuit, said circuit means including other circuit elements serving to advance the tray in one direction, said reversing circuit serving to advance the tray in the other direction; and

(b) other means controlled by said input means for de-energizing said reversing circuit when a selected space occupies a first relationship to the previously selected space and to energize said reversing circuit when a selected space occupies an opposite relationship to the previously selected space.

6. The projector according to Claim 5 further defined by:

(a) said circuit means including a first transistor and a first relay controlled thereby which are energized when said tray is advanced in said one direction;

(b) said reversing circuit including a second transistor and a second relay controlled thereby which are energized when said tray is advanced in said other direction; and

(c) said other means including means for alternatively triggering said first and second transistors into conducting conditions.

7. The projector according to Claim 2 wherein means are provided for advancing said tray a minimum distance to present the selected tray space adjacent the projection gate, said means comprising:

(a) said circuit means including a reversing circuit, said circuit means including other circuit elements serving to advance the tray in one direction, said reversing circuit serving to advance the tray in the other direction; and

(b) other means controlled by said input



energize the circuit when a number between "81" and "100" is selected. Or in other words, when the selector switch 142 is in the "eighty" position, it is only possible to energize the circuit when tray spaces "01" through "80" are selected. When the selector switch 142 is in the "100" position, it is possible to select any of the spaces between "01" and "100".

10 WHAT WE CLAIM IS:—

1. A projector of the type having a projection gate and an associated tray with a plurality of spaces therein for receiving respective transparencies to be projected, comprising means for advancing said tray to present adjacent such gate any of said tray spaces selected at random said means comprising:

15 (a) input means for selecting any of the spaces in said tray; (b) first variable resistance means operated by said input means for establishing a predetermined electrical resistance for each selection made by the input means; (c) an electric motor for advancing said tray; (d) second variable resistance means operated by said motor simultaneously with movement of said tray thereby, said variable resistance means serving to establish a predetermined electrical resistance for each position of said tray as defined by the spaces therein being presented one at a time adjacent said gate; and (e) circuit means connecting said motor and said first and second variable resistance means and adapted to energize said motor when the respective resistances established by said first and second variable resistance means are in a first relationship with respect to each other and to de-energize said motor when the respective resistances established by said first and second variable resistance means are in a second relationship with respect to each other.

2. The projector according to Claim 1 further defined by:

45 (a) said input means including a "tens" selector and a "units" selector for selecting any number between unity and a maximum number;

50 (b) said first variable resistance means including a pair of variable resistors operated respectively by said "tens" and "units" selectors;

(c) said second variable resistance means including another pair of variable resistors; and

55 (d) means driven by said motor simultaneously with movement of said tray thereby to vary the resistances of said another pair of variable resistors at a ratio of 10:1 with respect to each other.

60 3. The projector according to Claim 2 wherein said means driven by said motor includes fixed and movable "tens" contacts and fixed and movable "units" contacts, the latter being arranged in a vernier relationship with

each other, said movable contacts being moved by said means driven by said motor. 65

4. The projector according to Claim 3 further defined by:

(a) said fixed "tens" contacts being in the form of a plurality of segments arranged in a continuous annular pattern; 70

(b) said movable "tens" contacts being a single contact arranged to engage said segments one at a time in seriatim;

(c) said fixed "units" contacts being spaced from each other according to an arcuate pattern such that all of the fixed "units" contacts considered together define a segment the arcuate extent of which is equal to one of said fixed "tens" contact segments; and 75

(d) said movable "units" contacts being defined by a plurality of contact fingers, said fingers and said fixed "units" contacts being arranged such that only one of the latter may at any one time be engaged by anyone of the former. 80

5. The projector according to Claim 1 wherein means are provided for advancing said tray the minimum distance to present the selected tray space adjacent the projection gate, said means comprising: 85

(a) said circuit means including a reversing circuit, said circuit means including other circuit elements serving to advance the tray in one direction, said reversing circuit serving to advance the tray in the other direction; and 90

(b) other means controlled by said input means for de-energizing said reversing circuit when a selected space occupies a first relationship to the previously selected space and to energize said reversing circuit when a selected space occupies an opposite relationship to the previously selected space. 95

6. The projector according to Claim 5 further defined by: 100

(a) said circuit means including a first transistor and a first relay controlled thereby which are energized when said tray is advanced in said one direction; 105

(b) said reversing circuit including a second transistor and a second relay controlled thereby which are energized when said tray is advanced in said other direction; and 110

(c) said other means including means for alternatively triggering said first and second transistors into conducting conditions. 115

7. The projector according to Claim 2 wherein means are provided for advancing said tray a minimum distance to present the selected tray space adjacent the projection gate, said means comprising: 120

(a) said circuit means including a reversing circuit, said circuit means including other circuit elements serving to advance the tray in one direction, said reversing circuit serving to advance the tray in the other direction; and 125

(b) other means controlled by said input



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- means for de-energizing said reversing circuit when a selected space occupies a first relationship to the previously selected space and to energize said reversing circuit when a
5 selected space occupies an opposite relationship with the previously selected space.
8. The projector according to Claim 7 further defined by:
- (a) said circuit means and said reversing
10 circuit being controlled by first and second switching means, respectively; and
- (b) first and second circuit element means alternatively connected in said circuit means depending on the extent of movement of said
15 "tens" selector.
9. The projector according to Claim 8 wherein said first and second circuit element means are alternatively connected in said circuit by a mono-stable switch.
- 20 10. The projector according to Claim 1 wherein one of such associated trays has a greater number of spaces than another of such associated trays, and being further defined by: (a) said selection means including a selection member movable between first
25 and second positions for alternately connecting said first and second movable contact means in said circuit means and thereby adapting said projector for alternately operating one of said trays and the other of said
30 trays, respectively; (b) an initiate switch for closing said circuit thereby to energize said motor; and (c) other switch means in series with said initiate switch and operable when said selection member is in its second position
35 to prevent closing of said circuit when a number is selected by said input means which is greater than the number of spaces in said other tray.
11. A slide projector substantially as described herein and shown in the accompanying drawings. 40
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