April 29, 1958 C. W. FRANK 2,832,835

SELECTING SYSTEM UTILIZING ROTARY SWITCHES

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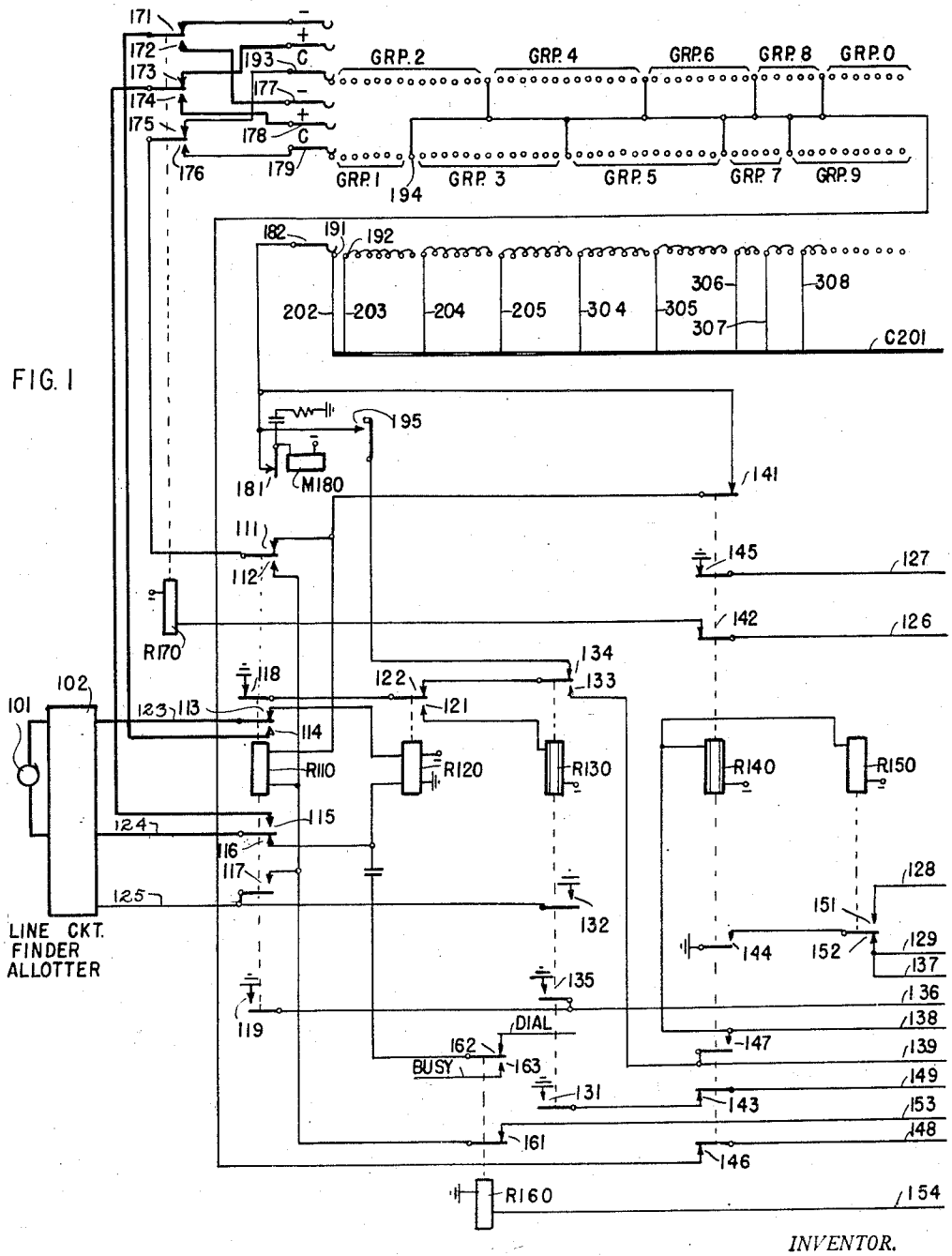
FIG. 1



INVENTOR.
CHARLES W. FRANK
BY Wm Watts Ewin

ATTY.

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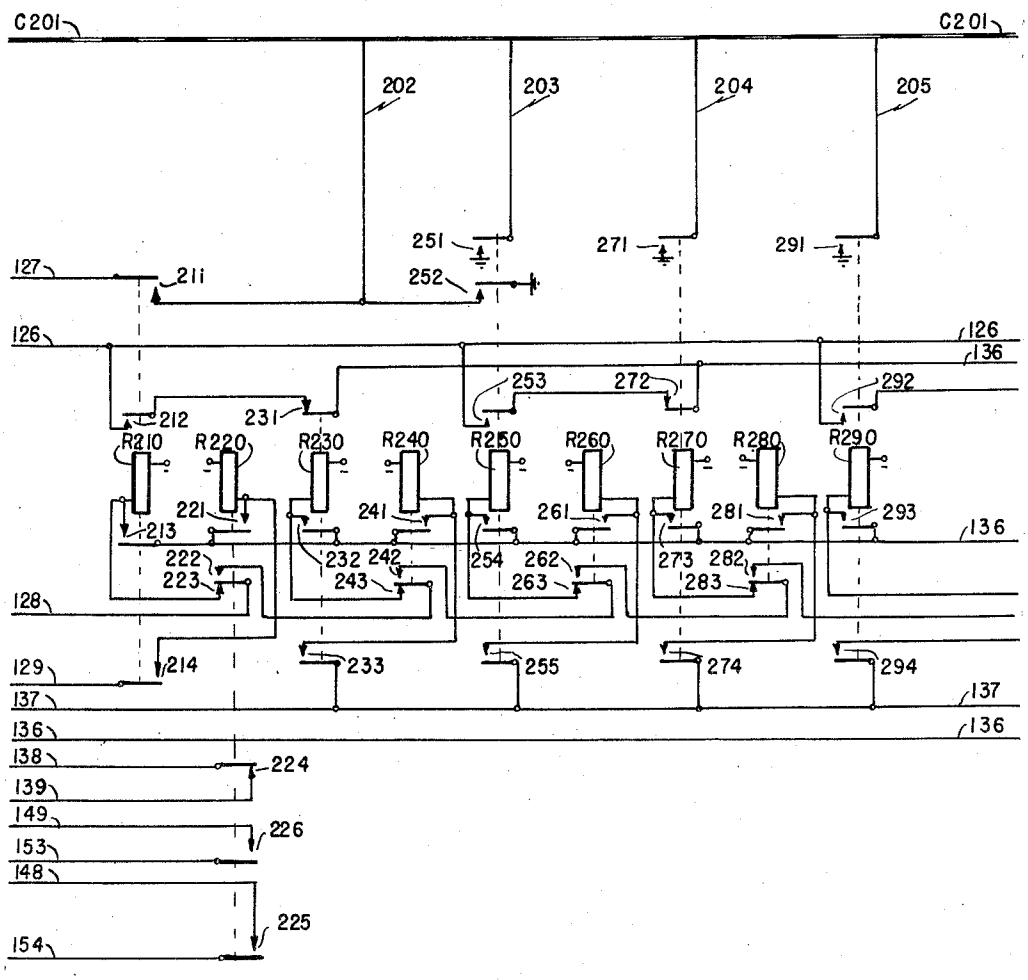
FIG. 2



INVENTOR.
CHARLES W. FRANK

BY Wm Walter Drew

ATTY.

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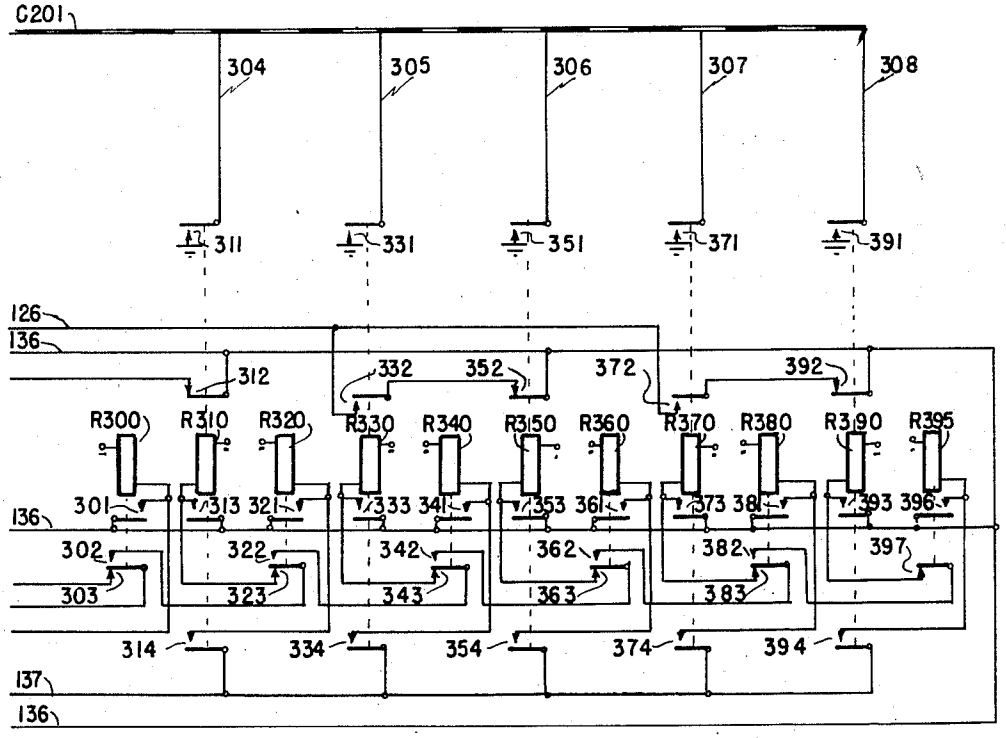
FIG. 3



INVENTOR.
CHARLES W. FRANK

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2,832,835

SELECTING SYSTEM UTILIZING ROTARY SWITCHES

Charles W. Frank, Wheaton, Ill., assignor to General Telephone Laboratories, Incorporated, a corporation of Delaware

Application April 27, 1953, Serial No. 351,086

5 Claims. (Cl. 179—18)

This invention relates in general to telephone systems and more particular to single motion numerical switches for use in such systems.

A serious difficulty encountered in the original rotary systems had been the problem of assuring proper outlet group selection in response to digital impulses. Since it is necessary to minimize the time necessary for completing calls, it is desirable to select the desired outlet group concurrent with the receipt of impulses. Therefore, in numerical rotary switches, it has been necessary to step the wipers across one numerical group of outlets to the start position of the next numerical group during the time interval of one impulse, usually one-tenth of a second in order to advance the wipers to a desired group in response to a digital series of impulses.

As a result, various attempts have been made to develop switches with a more rapid stepping speed—e. g. the switch shown in the United States Patent No. 2,522,715. However, mechanical limitations have so far prevented a foolproof answer by the use of rapid-action switches to the problem of "skipping over" groups having a large number of outlets.

It is submitted that applicant has, by new and novel means disclosed herein and preferably for use in conjunction with rapid-action switches, solved the above said problem.

It is the object of this invention to provide new and novel means in a single motion switch for reducing the time necessary to advance the wipers therein from one group of contacts to the next.

A feature of this invention is the new and novel arrangement, in a single motion switch, of the bank contact groups whereby fewer operations of the motor magnet, than there are contact positions in a group, are required to step the wipers from group to group.

Other features will be evident upon a perusal of the following disclosure, which is given by way of example only. In the attached drawings, which disclose one exemplification of the invention,

Figs. 1, 2 and 3 show a single motion selector switch; and

Fig. 1 also shows in the form of a block diagram a subscriber line, a line circuit associated therewith, a finder for extending said line to said selector and an allotter associated with said line for taking said finder into use.

It will be noted that various arrangements of the selector bank contacts may be used; and, when two sets of wipers are used as shown herein, the first position in a group accessible to one wiper set is preferably arranged at approximately the center position of the preceding group accessible to the other wiper set. Obviously the staggered arrangement can be practised in a numerical switch having more than two sets of wipers thereby decreasing the number of steps between numerically succeeding outlet groups.

In the selector shown herein, two sets of wipers are used, each set having access to five groups of bank contacts. An extra control bank together with a chain of counting relays are used to advance the wipers from group to group in response to successive impulses. The even numbered groups (GR2–GR0) are accessible to one set of wipers and the odd numbered groups (GR1–GR9) are accessible to the other set. A wiper switching relay R170, controlled by the counting chain determines the wiper set over which the selector will hunt for an idle trunk.

The 20-relay counting chain disclosed herein has been selected as the preferred embodiment to permit a simple explanation of the wiper switching and group skipping operations. Obviously the counting chain could be arranged in a manner similar to several "reflexed" counting chain circuits well known in the art, that is, relays R250 to R320 could be restored and reoperated to perform the functions respectively of relays R330 to R395. The general principle of "reflexing" is disclosed in United States Patent No. 1,226,184.

The trunking arrangement shown herein is such that the trunk groups have varying numbers of trunks therein.

Operation of the selector

Assume that a call, initiated at substation 101, has been extended by way of the line circuit, finder and allotter combination 102 to conductors 123, 124 and 125 of the selector shown herein. Line relay R120 will be operated over a circuit including the calling loop, conductors 123 and 124 and contacts 113 and 116; and dial tone from the dial tone equipment (not shown) will be extended to the calling loop by way of contacts 162 and 116 and conductor 124.

R120 will complete at contacts 121 an obvious circuit for operating hold relay R130, the latter closing contacts 132 to ground conductor 125 thereby to busy mark the selector.

In response to the first impulse in a first digital series of impulses dialed over the calling line, line relay R120 will restore to close contacts 122 thereby to complete a pulsing circuit including contacts 118, operated contacts 133 of the hold relay, conductor 139, contacts 224 and conductor 138 for operating changeover relay R140 and relay R150.

At contacts 144 and 151, relays R140 and R150 complete a circuit including conductor 128 and contacts 223 for operating the counting relay R210; and, at contacts 147, R140 completes an alternate pulsing circuit for maintaining R140 operated and operating R150 by succeeding pulses after R220 opens contacts 224.

R210 closes contacts 211 to prepare a circuit including contacts 145, conductors 127 and 202, cable C201 to Fig. 1 and contact 191 for operating motor magnet M180 if the first digit is 1 or 2; closes contacts 212 to prepare a circuit for operating wiper switching relay R170 if the first digit is 1; closes contacts 213 to maintain itself operated over a circuit including conductor 136 and contacts 135; and closes contacts 214 to prepare a circuit for operating R220.

Relays R130 and R140 are slow to release and therefore remain operated during said series of impulses. When R120 reoperates at the end of the first impulse and R150 restores in response thereto, relay R220 operates over a circuit including contacts 214, conductor 129 and contacts 152 and 144. R220 closes contacts 221 to maintain itself operated over the circuit used by R210 for maintaining itself operated; at contacts 222, extends the conductor 128 to the second counting relay R230 by way of contacts 243; and, at contacts 226, prepares a trunk hunting test circuit for switching relay R110 and motor magnet M180.

In response to a second impulse R120 will again restore and R150 operate; however, when contacts 151

are again closed to ground conductor 128, the second counting relay R230 is operated. At contacts 231, R230 opens the circuit prepared for wiper switching relay R170; at contacts 232 locks itself operated by way of conductor 136; and, at contacts 233, prepares a circuit for operating relay R240.

At the end of the second pulse, R120 reoperates and R150 restores to operate R240 over a circuit including contacts 144 and 152, conductor 137 and contacts 233. R240 closes contacts 241 to lock itself operated by way of conductor 136 and also closes contacts 242 to extend conductor 128 to the third counting relay R250 by way of contacts 263.

In a similar manner relays R250 and R260 operate and lock themselves operated in response to a third impulse, and relays R270 and R280, R290 and R300, R310 and R320, R330 and R340, R350 and R360, R370 and R380 and R390 and R395 operate and lock respectively in response to a fourth, fifth, sixth, seventh, eighth, ninth and tenth impulses.

Contacts 253 and 272, 292 and 312, 332 and 352, 372 and 392 will, when operated, alternately prepare, then open, circuits for operating switching relay R170.

When R250 operates in response to a third impulse it closes contacts 252 to complete a circuit including conductor 202, cable C201 to Fig. 1, contact 191, wiper 182 and contacts 181 for operating magnet M180 to step the wipers to the next contacts, wiper 182 engaging contact 192. R250 also closes contacts 251 to prepare a circuit including conductor 203, cable C201, contact 192 and those multipled therewith, wiper 182 and self-interrupting contacts 181 for operating magnet M180 to step the wipers to the third group of contacts GR3, said circuit being completed when wiper 182 engages contact 192.

Similarly contacts 271, 291, 311, 331, 351, 371, and 391 will, when operated by the operation of their respective relays, complete circuits for respectively advancing the wipers to groups GR4, GR5, GR6, GR7, GR8, GR9 and GR0.

Thus it will be seen that (1) the wipers are advanced to odd numbered groups of outlets in response to odd numbered digits and to even numbered groups of outlets in response to even numbered digits; (2) that a circuit it prepared in response to odd numbered digits for operating wiper switching relay R170 to switch connections from the wiper set having access to even numbered groups to wipers 177, 178 and 179 which have access to the odd numbered groups; and (3) that the magnet M180 steps the wipers over only half of the outlets in a numerical group to advance said wipers to the next numerical group. Obviously a substantial reduction in the time necessary to step the wipers from group to group is achieved.

Upon the termination of the series of impulses, which by way of example we will assume to be only one impulse, line relay R120 is operated and relay R150 is restored as previously described. After a short time delay, changeover relay R140 will restore to close contacts 142 to operate the wiper switching relay R170 over a circuit including conductor 126, contacts 212 and 231, conductor 136 and contacts 135. At contacts 172, 174 and 176, connections are completed to the odd group wipers 177, 178 and 179.

Also when R140 restores contacts 145, a circuit including conductor 127, contacts 211, conductor 202, cable C201 to Fig. 1, contacts 191, wiper 182, and contacts 181 is completed for operating magnet M180 to step the wipers to the first bank position of group GR1 in preparation for the trunk hunting operation.

When R140 restores contacts 141 and 143 the trunk hunting test circuit is completed. The selector searches for absence of ground, each busy trunk having ground potential connected to its associated private contact—i. e. the contacts accessible to wipers 179 and 193. Since contacts 176 are closed, the motor magnet M180 will be operated to move the wipers one step, each time that

wiper 179 encounters ground, over a circuit including contacts 176, 111, 141 and 181. As long as ground is encountered by wiper 179, the winding of switching relay R110 is short circuited by ground potential over wiper 179, contacts 176 and contacts 111 to the upper terminal of R110 and by ground potential over contacts 131 and 143, conductor 149, contacts 226, conductor 153 and contacts 161 to the lower terminal of R110.

If all the trunks in group GR1 are busy the wipers will be advanced until wiper 179 encounters contact 194 at which time the all trunks busy relay R160 will be operated over a circuit including conductor 154, contacts 225, conductor 148, contacts 146, bank contact 194, wiper 179, contacts 176, 111, 141, 181 and M180; but M180 will not operate in series with R160. Wiper 179 does not encounter direct ground at this time; and, therefore, R110 is no longer short circuited. If R110 should operate at this time over a circuit including contacts 131 and 143, conductor 149, contacts 226, conductor 153, contacts 161, the winding of R110, contacts 141 and 181, and magnet M180, R110 will be restored by R160 opening contacts 161. At contacts 162 and 163, R160 removes dial tone from the calling loop and substitutes thereon busy tone from busy tone equipment (not show). If the calling subscriber should then abandon the call, line relay R120 will restore, followed, after a short time delay, by hold relay R130. At contacts 131, R130 opens the operating circiut of R110; at contacts 134, short circuits R160 to restore it and completes a circuit including contacts 118 and 122, off-normal contacts 195, and self-interrupting contacts 181 to operate M180 until the wipers return to normal at which time off-normal contacts 195 open to open said circuit; and at contacts 135, opens the operating circuit of R170 and the locking circuits of R210 and R220 to restore them (if any of the relays R230 to R395 had been operated they too would restore).

If any one of the trunks in group GR1 had been idle, wiper 179 would not encounter ground on the private contact associated with said idle line; and switching relay R110 would operate over the circuit previously described. At contacts 114 and 115, R110 will extend the calling loop to said idle trunk by way of contacts 172 and 174 and wipers 177 and 178; and, at contacts 113 and 116, will open the operating circuit of line relay R120 which relay restores followed by hold relay R130.

R130, restoring, will not cause M180 to restore the wipers to normal since the restoring circuit is open at contacts 118; and R130 will not cause R170, R210 and R220 to restore since contacts 119 complete an alternate holding circuit for said relays before contacts 135 open the original holding circuit.

Assuming that said idle trunk terminates in a connector switch of a type well known in the art—e. g. that shown in United States Patent No. 1,716,986—the line and hold relays thereof will be operated in a manner well known in the art when the calling loop is extended to said connector line relay. The hold relay will return a busy marking ground potential to the private contact upon which wiper 179 is standing, which potential is extended to private conductor 125 by way of wiper 179 and contacts 176, 112 and 117 and which potential maintains switching relay R110 operated after hold relay R130 restores to open the original operating circuit of R110 at contacts 131.

At the termination of the call, the connector line and hold relays will restore in a manner well known in the art. The busy marking ground potential returned by said connector will be removed and R110 will restore. At contacts 118, R110 will completee the previously described circuit for operating M180 to return the wipers to normal; and, at contacts 119, it will restore relays R170, R210 and R220 as previously described.

It is to be understood that various modifications of the embodiment shown may be made, and it is intended

to cover in the appended claims all such modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. In a single-motion numerical switch, a plurality of wiper sets and sets of bank contacts accessible to each of said wiper sets, magnet means for moving said wiper sets, each set of contacts arranged in groups of contacts, certain of the first contacts in each of said groups engaged by the respective wiper set having access thereto in a position of said wiper sets different from positions in which all of the first contacts in other groups are engaged by their respective wiper sets, said wiper sets and groups arranged for the engagement, by their respective wiper sets, of said certain first contacts in each of said groups, as said wiper sets are moved, followed by the engagement, by the respective wiper set, of one of the certain first contacts in a group of another set of contacts, means whereby said magnet means is operated responsive to and concurrent with succeeding impulses in a series of impulses received by the switch to step the wipers from group to group, the movement of the wipers from group to group including fewer steps then there are contacts in a group, and means controlled by said last means for rendering one wiper set effective.

2. In a single-motion numerical switch having a plurality of wiper sets and rows of bank contacts accessible to each of said wiper sets, said rows arranged such that said sets of wipers simultaneously move across their respective rows of contacts, the contacts in each of said rows arranged in groups, the bank positions of the first contacts in certain groups accessible to each of said wiper sets offset from the bank positions of the first contacts in all other groups, means operated responsive to and concurrent with successive impulses in a digital series of impulses for stepping said wipers to successive bank positions of the first contacts of said groups, and means operated responsive to said series of impulses for switching through connections to a predetermined one of said wiper sets, dependent upon the number of impulses in said series.

3. In a selecting system, a rotary switch having incoming conductors over which impulses are received, a pair of wiper sets, groups of outlets accessible to each wiper set, a plurality of said groups accessible to one of said wiper sets arranged in staggered relationship to a plurality of said groups accessible to the other wiper set, a common control wiper and a contact set accessible thereto, means operated responsive to successive impulses received over said incoming conductors for differently marking said contact set, circuits completed responsive to said common control wiper encountering said different markings for operating said magnet to move wipers to alternately engage the first outlets in said one then said other plurality of groups while impulses are being received, the movement of said wipers from one group to another including fewer steps than there are outlets in said one group, said wipers thereby advanced to the first outlet in a wanted group of outlets in response to a series of impulses received over said conductors, and means dependent upon the number of impulses in said series for rendering one set of wipers effective and the other set ineffective, the wipers having access to said wanted group thereby effective in response to said series of impulses.

4. A single-motion numerical switch comprising magnet means, a driving element actuated by said means, a plurality of sets of wipers and contact banks, said wipers being carried by said driving element, a plurality of groups of outlets connected to each of said sets of banks, each group having a start position and said groups being connected to the various sets of banks in such relation to the respective sets of wipers that contacts corresponding to start positions of the groups connected to one set of banks and contacts corresponding to start positions of the groups connected to another set of banks are engaged by the respective wiper sets in different positions of said driving element and in cyclically alternating relation, means for causing said magnet means to be operated responsive to and concurrently with the receipt of a series of numerical impulses a given number of times per numerical impulse to step the wipers to succeeding group start positions, whereby said wipers are advanced over positions corresponding to outlets of unwanted groups to the start position of the wanted groups, and means operative depending on the number of received impulses for selectively making one of said wiper sets effective.

5. A switch as claimed in claim 4 wherein said second-mentioned means comprises a circuit including a common control wiper carried by said driving element and groups of common control bank contacts accessible to said common control wiper and relay means operated responsive to succeeding impulses in said series of impulses for marking each succeeding common control group to complete said circuit for operating said magnet means to step the wipers past each common control group.

References Cited in the file of this patent

UNITED STATES PATENTS

1,903,207	Wicks et al.	Mar. 28, 1933
1,914,384	Richardson	June 20, 1933
2,635,147	Stehlik	Apr. 14, 1953
2,646,466	Bakker	July 21, 1953
2,721,902	Pharis	Oct. 25, 1955