Jan. 28, 1964 F. G. NICOLAUS 3,119,905

STEP SWITCH WITH EXTENDED CONTACT RANGE

Filed Feb. 3, 1960 4 Sheets-Sheet 1

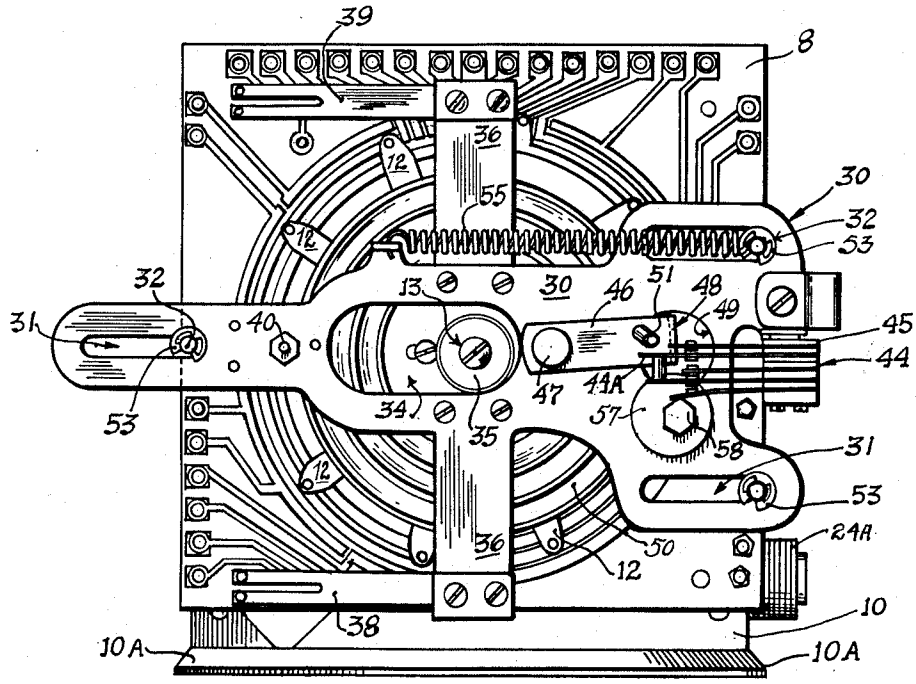

Fig. 1.

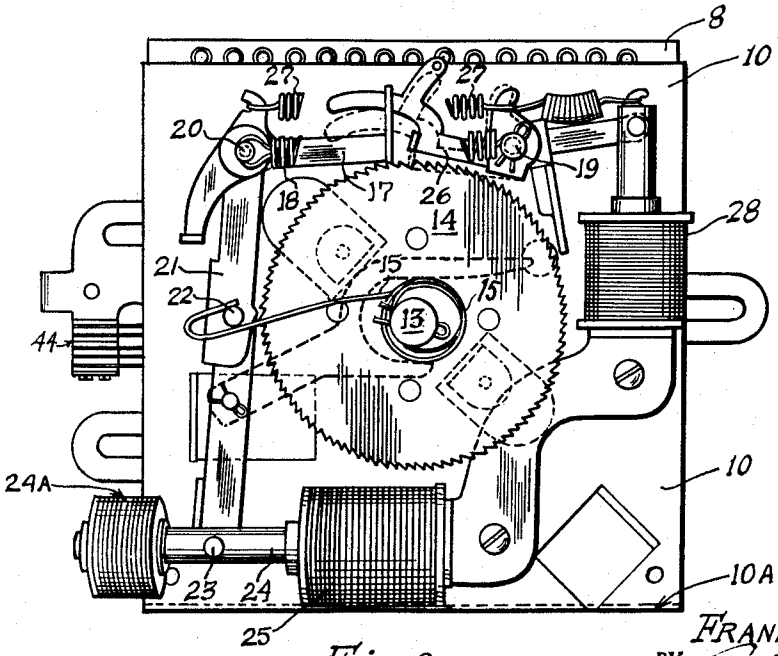

Fig. 2.

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STEP SWITCH WITH EXTENDED CONTACT RANGE

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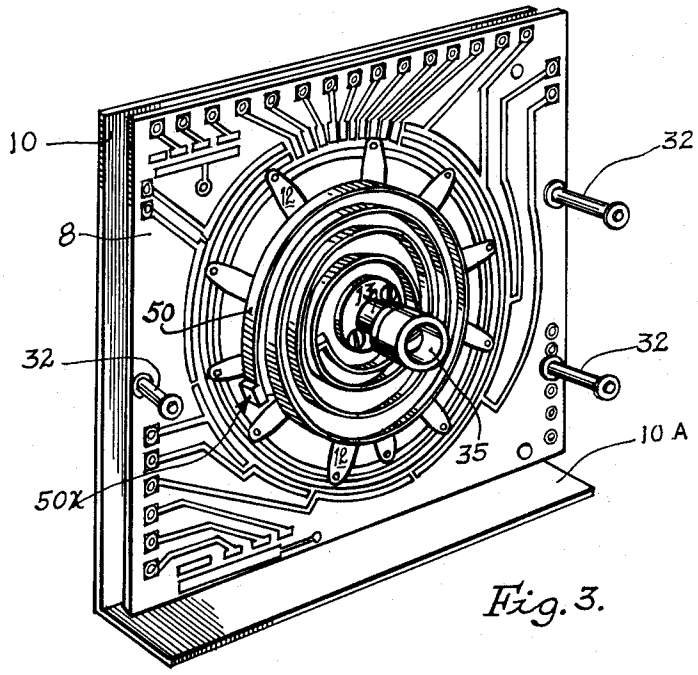

Fig. 3.

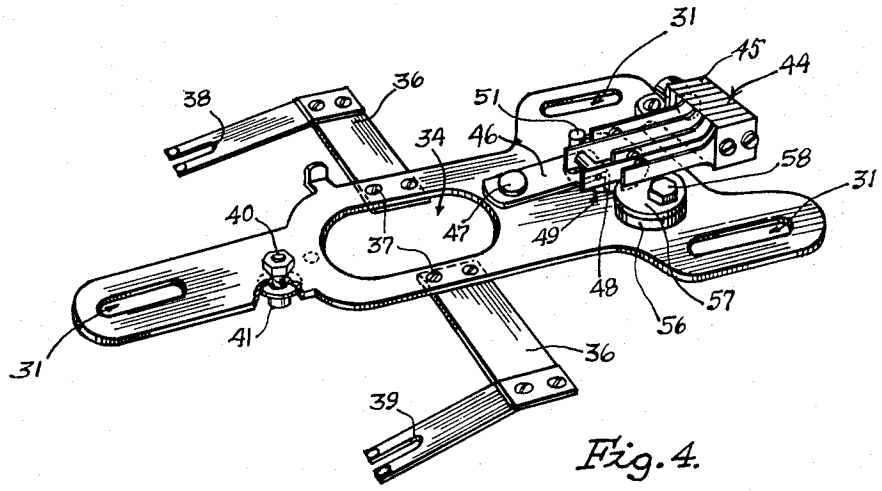

Fig. 4.

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STEP SWITCH WITH EXTENDED CONTACT RANGE

Filed Feb. 3, 1960 4 Sheets-Sheet 3

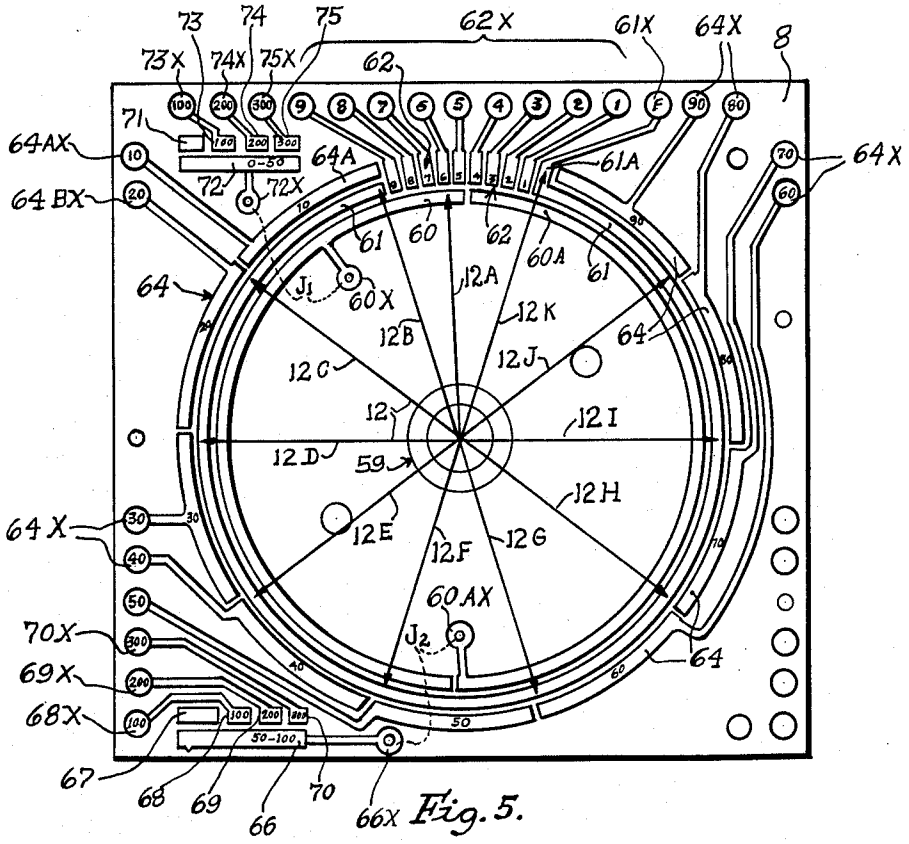

Fig. 5.

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STEP SWITCH WITH EXTENDED CONTACT RANGE

Filed Feb. 3, 1960 4 Sheets-Sheet 4

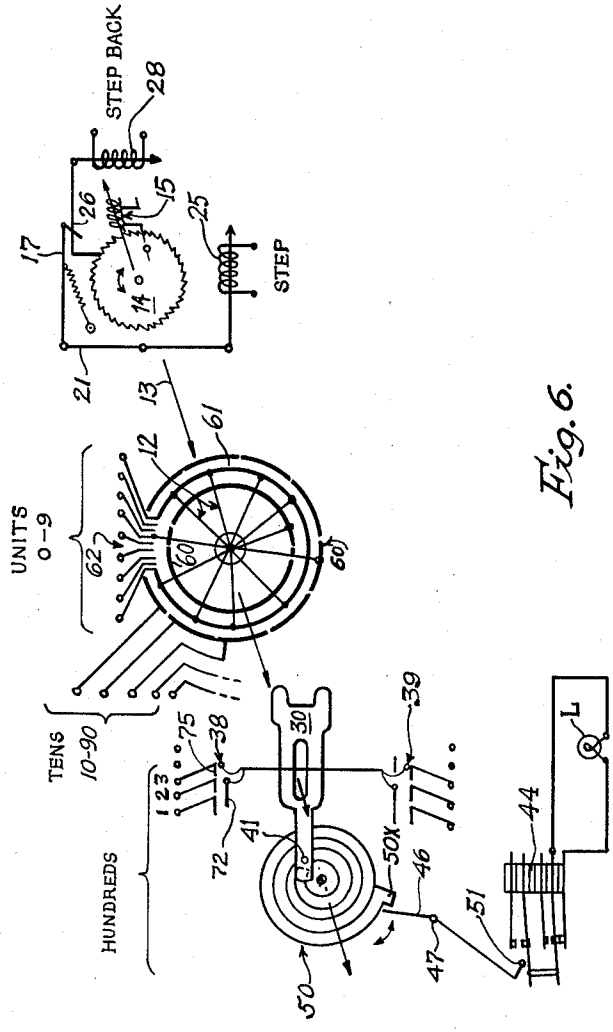

Fig. 6.

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United States Patent Office 3,119,905 Patented Jan. 28, 1964

3,119,905

STEP SWITCH WITH EXTENDED CONTACT RANGE

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Filed Feb. 3, 1960, Ser. No. 6,481
8 Claims. (Cl. 200—11)

This invention pertains to improvements in electrical switching apparatus involving movable and stationary contacts, the principal object being the provision of an array of such contacts involving both angular and linear parameters by means of which a relatively greater number of switching connections can be had in a minimized space.

A further object is the provision of a system of stationary and movable contacts arranged in a predetermined available area to afford a greatly extended contact range.

Still another object is the provision of a simple type of stepping switch capable of counting sequentially in units, tens, and hundreds, by means of a special contact scheme in the absence of which many more contacts and wiring connections would be required, together with more space, to achieve a similar switching or counting capacity.

Additional objects relate to details of the contact shape and disposition and the mechanism for actuating the movable contact means.

Still further aspects of novelty and utility will appear as the following description proceeds in view of the annexed drawing, in which:

FIG. 1 is a front elevation of the device;

FIG. 2 is a rear elevation thereof;

FIG. 3 is a front perspective thereof with the transfer unit removed and displayed in FIG. 4;

FIG. 4 is a perspective of the traverse carrier removed;

FIG. 5 is a plan view of the extended-range contact panel;

FIG. 6 is a partial schematic of the contact and switching system;

A brief introductory description of operation in view of FIG. 6 appears heretinafter.

Introductory Statement of Operation

Referring to FIG. 6, impulse energizations of the stepping solenoid **25** will oscillate the driving pawl means **21**, **17** to step the ratchet wheel **14** and turn the spindle **13** and its complement of contact wiper fingers **12** relative to the concentric primary contact array or system **60**, **61**, **62** etc., while at the same time turning the spiral tracking member **50**, which will cause the follower pin **41** to follow the spiral track and thereby advance the traverse carrier **30** from left to right, the carrier being shown in FIG. 6, however, shifted fully to the right to the limit of its counting travel, in which condition the outboard lug **50X** on the spiral member will engage and pivot the supervisory switch lever **46** and actuate the supervisory blade switch means **44** at **51** for the purpose of controlling any desired circuit including, for example, a signal lamp L to indicate the end of the count and necessity, in this embodiment at least, for a resetting operation by return spring **15**, as by simultaneous energization of both the stepping and release ratchet solenoids **25** and **28**, which will cause disengagement of both the stepping and holding pawls **17** and **26**, in accordance with the operation of the patented step-up mechanism alluded to elsewhere herein.

Upon resetting, the traverse carrier **30** shifts to its starting position toward the left (FIG. 6) and the set of eleven angularly travelling contacts or wipers **12** rotates back to a corresponding starting position, as depicted in

FIG. 1, so that pulses to the stepping solenoid **25** may again cause the ratchet wheel to be advanced step-by-step along with the set of wipers **12**; and simultaneously therewith the spiral tracking member **50** will rotate and shift the carrier **30** slowly back toward the right for the purpose of counting off "hundreds" values, while the wiper fingers **12** count off "units" and "tens" in repetitious cycles, the total "hundreds' value of which is accumulated by the slower-moving traverse contacts **38**, **39** in shifting along the linear contact means **72—75**.

The units will be counted off at different times by all but one of the wipers **12**, one full revolution of the shaft **13** corresponding to each count of 100, the operation and simple circuitry of the device acting to hold the circuit values for the "tens" count during each "units" count, and to hold the circuit values for the "hundreds" count during each "tens" count, as will appear more fully hereinafter in connection with the detailed explanation of the contact system depicted in FIG. 5.

In one of its forms, the new switching means is embodied in a stepping switch of the type shown in FIGS. 1 and 2, consisting of a metal chassis **10** (FIG. 2) provided with a base portion **10A** (FIG. 1) and having mounted on its rear face, as in FIG. 2, driving and control means for advancing certain switch wipers **12** engageable with certain stationary contacts on an insulated panel **8** (FIG. 1) step-by-step from the starting position shown, or returning the same step-by-step, or optionally in one movement from an advanced position, such means comprising a shaft **13** suitably journalled on the plate to extend therethrough, there being a ratchet disc **14** fixed thereon on the driving side of the plate, as in FIG. 2, and a set of eleven wiper contacts **12** affixed to rotate therewith, along with a special spiral tracking plate **50** on the opposite or switching side of the plate, as in FIG. 1, or FIG. 3.

A torsion spring **15** (FIG. 2) carried on the spindle tends to rotate the ratchet disc to a normal starting position determined by the spiral tracking means, as will hereinafter appear, the ratchet being advanced step-by-step against the force of this spring by action of a driving or stepping pawl **17** pulled forward (toward the right) by a drive spring **18** anchored on a pivot pin **19** at one end and secured at its other end to another pivot pin **20** on a drive lever **21** pivoted on post **22**, and pivotally connecting at **23** to the armature **24** of a stepping solenoid **25**. A set of washers **24A** provides a regulatory inertia loading for the armature.

The gain of the ratchet is held by a holding pawl **26** urged into the dotted line position in the teeth by spring **27** but movable to the full line released position shown in FIG. 2 by action of release solenoid **28**. On the last permitted step, the holding pawl **26** will be held, as shown, in the raised releasing position by a special interlock (not detailed) with parts of the driving pawl, in accordance with the disclosures of U.S. Patent No. 2,895,340, to which reference should be made for details of this type of escapement feature, the construction being such that, following the interlocking action, the next ensuing operation of the driving pawl will release the holding pawl to its normally lowered dotted-line holding position for resumption of its escapement and holding functions. A back-stepping action may be had by pulsing the solenoid **28**; or the ratchet may be returned in a single motion by simultaneous energization of both solenoids.

Other forms of step-by-step contact-advancing means may be employed; and it may be desirable in some applications to drive the switching wipers in a continuous rather than intermittent action, there being no limitations in this respect upon the basic switching principle, as will more fully appear hereafter.

By whatever means the spindle 13 may be turned, the result on the switching side of the unit seen in FIG. 1 will be a synchronous advance of the set of spring contact wipers 12 and the spiral tracking means 14, the latter causing in turn a slow linear advance of the traverse contacting member or carrier 30 from a starting position shifted fully toward the left (FIG. 1) to the limit of its travel fully at the right.

The traversing contact carrier 30 is part of a "hundreds" counting means and consists of a somewhat elongated plate (FIG. 4) in which are formed three elongated parallel slide slots 31 in triangular array to seat slidably upon shouldered posts 32 (FIG. 3) fixed on the panel 8, there being a large central slot 34 to clear a knurled finger knob 35 (FIG. 1) fast on the spindle and used for manual setting of the contact wipers when desired.

A pair of lateral arms 36 is attached as at 37 to the carrier to project from opposite sides thereof and support spring blade contact wipers 38 and 39 to project in the direction of travel of the carrier for wiping engagement with certain eccentrically-located, linearly-arranged secondary or transfer contacts for accumulating the "hundreds" count, as will appear more fully hereafter.

Depending from the inside face of the carrier is a tracking pin 40 fitted at its end with a nylon bearing button 41 which travels in the spiral track of the tracking member 50.

A spring-blade supervisory stack switch 44 is bolted to a lug 45 on the carrier opposite the end of a lever 46 pivoted on the carrier as at 47 and having an offset lug 48 projecting through a hole 49 in the carrier with a position where it can be engaged by a radially projecting abutment 50X at the end of the spiral cam track seen in FIGS 3 and 6.

On return of the spiral member (clockwise) from the position of FIG. 1 this abutment 50 will be effective to pivot the lever 46 downwardly from the raised end-limit switch-actuating position of FIG. 1 to cause an insulated switch-actuating pin 51 fixed thereon to bear down upon the spring switch blade 44A to shift the position of the contacts for the control of any desired supervisory circuits.

The traverse carrier is secured for sliding movement on the posts 32 by suitable spring washers 53, as in FIG. 1, and is urged toward the right in the direction away from its starting position by a long traction spring 55 to render its advancing travel smoother cooperatively with the spiral tracking means. Whenever the two pawls 17 and 26 are released the torsion spring 15 will turn the ratchet disc, the set of contact wipers, and the tracking members jointly back from any advanced position to the starting position shown in FIG. 1.

Adjustable shock-absorbing stop means for limiting the switch-actuating impact of the supervisory switch lever 46 is provided on the outside face of the carrier member (FIG. 4) in the form of a rubber washer 56 backed by a metal washer 57 and both secured to the carrier by a screw 58 passed therethrough eccentrically, so that as viewed in FIG. 1, by loosening the screw the set of eccentric washers may be turned clockwise to higher levels adjacent the hole 49 for engagement by the end of the lever to stop the latter at higher positions farther above the switch blades to protect the latter from shock and damage when the spiral tracking member is turned vigorously back to home position by spring 15.

An extension of the total switching range or contact capacity is achieved by the interdependent action of the set of eleven angularly shiftable or rotatable contact fingers 12 and the traverse wipers 38 and 39 with respect to an especially contrived system of angular and linear stationary contacts arranged on the contact panel 8 in the peculiar relationship depicted in FIG. 5 and heretofore briefly alluded to in connection with FIG. 6.

The panel 8 may be any rigid insulating material suitable to printed circuit techniques, such as Bakelite, Micarta and like resinous synthetics, said panel having a central opening 59 for passage of the ratchet spindle 13 upon which the assembly of eleven contact fingers 12 will be carried to rotate about an axis which is the center of the concentric part of the stationary contact system comprising angularly-extensive contacts and radial bridging contacts situated at angular intervals, as distinguished from the eccentric part of the system including the linear contacts, which are nevertheless also related to said center in a certain manner.

Referring to FIG. 5, the concentrically arranged angular primary array of contacts comprise two semi-circular inner segments 60 and 60A each having a terminal 60X or 60AX from which jumper-circuit connections will usually be taken off through to the reverse side of the panel, as indicated by dotted-line jumpers J_1, J_2.

Next about the inner ring is an angularly gapped median "ring" 61 lacking in a gap portion only about 30 degrees of being a complete circle, and having a radial end portion 61A connecting with a terminal 61X, it being important to observe that the radial end portion 61A extends radially outward into the zone of the next outer ring of primary contacts where it can be engaged by any contact wiper which may be travelling in this outer arc, as well as by any other wiper travelling through the median arc. In other words, the radial contacts or zones share at least two arcs of travel of the wiper fingers.

At this juncture it is oportune to describe the remaining common radial or spanning "units" contacts 62 of which there are a group of nine representing the ordinal digits one to nine, and each provided with corresponding terminals 62X. These spanning contacts appear serially in the angular gap between the ends of the median ring, the radial length of these spanning "units"-counting contacts being such as to span across the arcuate track of both the inner and outer rings for engagement by wipers travelling in either of these zones.

Included in an outer ring zone are nine long arcuate contact segments 64 which are the "tens"-counting contacts, each of which is respectively designated by its numerical values in FIG. 5 counterclockwise from 10 to 90, each such contact being also provided with a terminal 64X likewise designated in the drawing with the respective numerical values 10 through 90.

The contacts described thus far are angularly related and concentric to the spindle axis for the wipers, but the system includes a limited number of linearly-arranged "hundreds"-counting secondary contacts in two groups respectively located at the upper and lower left-hand corners of the contact panel.

In the lower linear group is one long common contact 66 and its terminal 66X designated by the numerical value 50–100; above this, appearing serially along, and parallel with, the length of the common linear contact, are four more shorter ones, the first of which is a blank contact 67, while the second one, 68 and its terminal 68X, is designated for the value 100; and the third and fourth contacts 69 and 70, together with their respective terminals 69X and 70X, are consigned to the values 200 and 300.

The second and remaining group of linear transfer contacts at the top of the panel includes a similar number and array of linear contact bars and their respective terminals 71; 72—72X; 73—73X; 74—74X, also respectively designated on the drawing by corresponding numerical values 0 to 50; 100; 200; 300.

The eleven rotary wiper contacts are generally designated by the reference character 12 and are shown as arrows in FIG. 5 to indicate the relative zones or arcs of travel covered thereby in their rotation as a group, these contacts being connected in common and "grounded" through the spindle 13.

For purposes of tracing the switching action, the several individual wipers 12 will be distinguished by alphabetical suffixes beginning in FIG. 5 with the short inner-ring wiper 12A, which apparently is of a radial length

to sweep over only the two long innermost segments **60** and **60A**, this being the only rotary contact to engage these inner-ring segments, and serving as a power feeding connection to the others.

Reading to the left or counterclockwise, the next nine wiper fingers **12B . . . 12J** will be seen to travel over the contacts in the median ring only, while the last or eleventh wiper **12K** sweeps over the contacts in the outermost ring only, and is mainly concerned with "tens"-counting, except that once during each revolution or cycle it counts "units" in its initial phase.

Ten of the wipers **12B** through **12K** are angularly equally spaced around the axis, while the short inner-ring wiper **12A** is equally spaced in between the two flanking wipers **12B** and **12K**.

Thus, the illustrative embodiment of FIG. 5 discloses a contact scheme in which stationary contacts are arranged angularly in concentric rings with certain rotary wipers traversing each ring path, and some of the stationary contacts (e.g. **62**) extending radially into other ring zones, this part of the system providing a "units"- and "tens"-counting arrangement adapted to repetitious cycling for counting in units from zero to one-hundred, the device also being capable of counting hundreds through the linear traverse contact means now to be described.

The first counting range from zero to 100 corresponds to one revolution of the shaft **13** and its set of wipers. Beginning at the starting (reset) condition shown in FIG. 5, it will be seen that the innermost wiper **12A** will traverse the first long, semi-circular stationary segment **60** for substantially one-half of a revolution; and during this same phase, the outermost wiper **12K** will in the first 30 degrees, more or less, of its displacement sweep over the set of units contacts **62** to make the count from one to nine; and on the tenth step or advance will come to rest upon, or engage, the first outer-ring segment **64A** designated for the value 10. Power is to be connected to the feed terminal F, also designated **61X**, at the top of the panel, and thus connects through the radial extension **61A** of the second median segment **60A**, thence through any of the wipers **12K** back to **12A** engaged thereon, and since all wipers are connected together or "commoned" it will be apparent that each of the "units" contacts **62** for the values 1 through 9 would be pulsed by the first wiper (e.g. **12K**) to traverse the same, and this wiper, upon advancing onto the first "tens"-counting segment **64A** in the outer ring, would render the same hot, so that any "tens"-indicating or sensing means (not shown) which might be connected to this terminal **64AX** would be energized, for example, a lamp designating the number 10 might be illuminated.

By the time the wiper **12K** is ready to leave the first "tens"-counting segment **64A**, the next succeeding wiper **12J** will be advancing onto the first of the digital contacts **62** to begin counting up the second "tens" group, and this kind of successive wiper action will be repeated until the count reaches 99, corresponding to substantially one revolution of the shaft **13** and substantially one revolution or spiral groove of the spiral tracking means **50**, and lacking only the one-hundredth step to complete the full revolution.

Since there is but the one outer-ring wiper **12K**, only one of the nine "tens"-counting segments **64A**, **64B**, etc., will be energized at a time during each 30-degree traverse of the digit-counting contacts in group **62**, and the nine terminals **64AX**, **64BX . . . 64I** will be successively energized, as aforesaid, until the count is 99, at which time, on the 100th step, the traverse or "hundreds"-counting wipers **38** will be lodged on linear contacts **72** and **73**, the latter corresponding to the value 100.

The linear contact **72** has its terminal **72X** connected by a jumper J_1, shown in dotted lines, to the terminal **60X** of the left semi-circular inner segment **60**; and it

may be here noted that the right-hand or second inner segment **61** has its terminal **61X** similarly connected by another dotted-line jumber J_2 to the terminal **66X** of the "50–100" linear contact **66**, as a result of which power will be connected to the "100" contact at **73** through the inner-ring wiper **12A** during the first half-revolution via **60**, **60X**, J_1, **72X**, **72** wipers **38** and "100" contact **73** at this stage of advance, which completes a count of the first 100 units during the first revolution of the spindle **13**, whether in step-by-step or continuous angular advance thereof.

On the second and subsequent revolutions of shaft **13** and its set of wipers, the counting operations will be the same, namely, picking up the first nine units by wiper **12K**, which thereafter will pick up successive "tens" groups, with subsequent groups of nine "units" values being picked up by the "middle arc" wipers **12B** to **12J** with corresponding accumulated counts of "tens," until the second and third 'hundreds" are counted off, the 200 count being sensed at linear contacts and terminals **69**, **69X**, **74**, **74X**, the reason for dual terminals on the 100—200—300 counts being the fact that the power wiper **12A** shifts from the left-hand semi-circular inner segment **60** to the right-hand segment **61** midway of the "50" count, which shifts power to the lowermost "50–100" common linear contact **66** via jumber J_2, whereas during the first half revolution in each cycle the "0–50" count is powered from inner semi-circular segment **60** via jumper J_1 in the upper linear group.

Thus, the capacity of the described embodiment is a total count of 350, by "units," "tens," and 'hundreds."

The range of the unit with respect to a contact scheme, such as shown in FIG. 5, can be extended greatly by multiplying the number of spiral tracks in the spiral traverse member **50**, it being observed that the latter as shown has only three and one-half tracks, by reason of which the count is limited to three and one-half 'hundreds," from which it is apparent that each "hundreds" count requires one full shift of the traverse carrier and its contacts, which in the embodiment shown corresponds to one complete spiral track.

For a greatly extended range which does not require too large a tracking member **50**, a suitably geared helical spiral or worm will preferably be substituted for the involute type of spiral employed on the member **50**, as now shown.

It will be apparent that while the principle of operation and arrangement of contacts in both angular and linear arrays, and the wipers cooperable therewith have been illustrated in an adaptation to the common decimal or base 10 system of counting, it is contemplated and apparent that the apparatus may be adapted to other pactical polynominal bases by adoption of the analogous contact arrays and contact wiper functions corresponding to the base desired.

I claim:

1. In a counting switch, a system of totalizing contacts comprising at least three concentric rings of stationary contacts, a shaft rotatable concentrically of said rings; a plurality of movable contact fingers each rotatable by connection with said shaft to engage certain of said rings of contacts, two adjacent ones of said rings of contacts including a plurality of separately connectible counting contacts electrically disconnected from one another and spaced by gaps therebetween which are radially elongated to lie in both said rings so as to be engaged by contact fingers traversing either ring, the contact fingers traversing at least one particular ring of said two adjacent rings being in such plural number and angular spacing that the contacts of said particular ring will each be traversed a plurality of times for each revolution of said shaft to count digital values in a totalizing circuit means connecting with said contact system.

2. A contact system according to claim 1 further characterized by the provision of a plurality of linearly-

arranged contacts, disposed adjacent said rings of contacts, together with linearly-moving contact means cooperable therewith, and a driving mechanism having driving inter-connection with said shaft for action in predetermined synchronism therewith such that certain different linear contacts are engaged by said linearly-moving contact means in each revolution of said shaft, at least.

3. An extended-range rotary type switching contact system including a contact panel having a plurality of concentric rings of contact areas located about the rotative axis of a set of contact wipers; a plurality, comprising a set, of contact wipers mounted to rotate about said axis, certain ones of which traverse certain contact rings, and means for rotating said set of wipers; a plurality of serially-arranged transfer contacts on said panel adjacent said rings; traverse contact means driven cooperatively with said set of wipers to shift position once per revolution of the set of wipers; certain successive contact areas in at least two particular ones of said rings constituting ring-sharing contacts and having portions located in both said rings along a common radius such that wipers traversing either of said particular rings can make connection with said ring-sharing contacts, the ring-sharing contacts in one of said particular rings being ten in number for counting unit values, and in another of said particular rings being nine in number for counting tens values; means including a third one of said rings and at least one certain wiper constituting a transfer wiper for effecting a transfer connection from the tens-counting contacts to certain of said transfer contacts depending upon the shift position of said traverse contact means in relation to the angular position of said transfer wiper, whereby to establish connections for counting hundreds, one for each complete traverse of the tens-counting wiper contacts by said wiper means, and terminal means on said panel with connections to said contact areas for establishing connections to contact areas having units, tens, and hundreds values.

4. A system of counting contacts for use in a rotary type switch adapted to establish connections for counting values in units, tens, and hundreds, at least, said system comprising a set of stationary contacts arranged in concentric rings, a set of transfer contacts situated adjacent said rings; a set of rotatable wiper contacts respectively adapted to rotate about the axis of concentricity of the rings to traverse certain of the same; traverse contact means shiftable to engage different ones of said transfer contacts; means for rotatively advancing in predetermined synchrony both the sets of rotary wiper contacts and the traverse contact means such that, for each complete traverse of a given ring of contacts counting tens values, a different transfer contact will be engaged by the traverse contact means; means providing for connection by certain wiper contacts between contacts in the ring of tens-counting values to certain transfer contacts for counting successive hundreds values; a set of at least ten contacts each angularly spaced to lie along a certain radius in a particular one of said rings and connecting with contact areas also located in an adjacent ring and respectively situated on the same radius as the counterpart in the particular ring, whereby wiper contacts travelling in either the particular or the adjacent ring can make contact with the same contact area on being positioned at the corresponding radius, whereby to count units values; and terminal means for establishing connection with each of said unit-value contact areas, said tens-value contacts, and said hundreds-value transfer contacts.

5. In a rotary type switch, a contact array for counting units and tens values repetitiously by rotated contact wipers, said array comprising: a first circularly-extending series of tens contact areas constituting tens contacts for counting tens values, nine of said areas being of substantially identical arcuate angular extent, and a tenth area thereof consisting of ten serial sub-contact areas spaced apart along the circular arc of said tens contacts, a first one of said sub-contacts constituting a power-connection contact and the remaining nine sub-contacts each constituting a units-counting contact; a second circularly-extending series of contacts substantially concentric with the first series and including nine secondary units contact areas each radially aligned with, and connected to, one of the 9 units contacts in the first-mentioned series, together with a contact area completing a long arc which contains the said nine secondary units contacts; and a set of 10 interconnected contact wipers and means mounting same to rotate jointly about the axis of concentricity of said contact array and including one particular wiper traversing said first series of contacts, and nine remaining wipers each serially traversing said second series of contacts, said wipers and the contacts of both series being angularly spaced such that, for each revolution of said particular wiper, the same will traverse nine units contacts and nine tens contacts, and said nine wipers will each traverse said nine secondary units contacts once, whereby to establish a count of 99.

6. A high-capacity, compact, switch of the counting type including a primary array of concentric arcuately-extending contact zones each including stationary contacts; a plurality of angularly travelling primary movable contacts and drive mechanism for rotating the same about the axis of concentricity of said stationary contact zones such that each said zone is traversed by at least one of the primary movable contacts for each revolution of travel thereof; an array of secondary stationary contacts and traverse contact means movable in sequential contacting engagement therewith to change in succession cumulative value connections each corresponding to completion of a certain amount of angular travel of the primary movable contact means; means conductively interconnecting certain contacts in the primary and secondary stationary contact arrays for permutating value connections established as a result of movements of the movable contact means; means drivingly interconnecting the primary and secondary movable contact means for synchronized coaction such that the secondary movable contact means changes connection in the secondary stationary contact array once in step with completion of a predetermined number of changes of connection of the primary movable contact means in the primary stationary contact array in each revolution of the primary movable contact means, whereby circuit connections to the stationary contacts are permuted to establish the cumulative value connections as aforesaid.

7. Switch mechanism according to claim 6 further characterized in that said primary and secondary stationary contact means are carried on the same panel and said primary stationary contact array includes a predetermined number of zone-sharing contacts appearing in succession along a predetermined arc of travel of the movable primary contact means so as to extend also in a radial sense into more than one of said concentric zones to be traversed by angularly travelling movable contact means which respectively traverse different ones of said shared zones; said interconnecting conductive means electrically interconnecting certain of the contacts in said primary array with certain contacts in said secondary array in a permutation pattern to establish a fixed count of contact circuit changes in the primary array in correspondence to each revolution of the angularly travelling contact means to correspond to each change in cumulative value connection effected in the secondary stationary contact array, the digit value of said fixed count depending upon the number of said zone-sharing contacts.

8. A high-capacity, compact counting switch comprising the provision on the same insulating panel of at least two separate arrays of contacts, one of which constitutes a primary array of stationary contacts which are traversed in succession by primary movable contact means

in two or more repetitious cycles for establishing digital counting connections, and the other of which constitutes a secondary array of stationary contacts which are traversed progressively in succession by secondary movable contact means to establish connections in succession each representing a cumulative value corresponding to completion of a predetermined number of said digital counting connections; drive mechanism operable to move said primary and secondary movable contact means in a synchronized relationship in which the secondary movable contact means moves to establish a new cumulative value connection as a function of each cyclic contacting traverse

by the primary movable contact means; and conductive connections between certain stationary contacts in both arrays for establishing circuit interconnections in accordance with a predetermined permutation pattern for establishing said value connections responsive to predetermined movements of movable contact means as aforesaid.

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