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3,198,921

CIRCULAR MULTIPLE CONTACT INDEXING SWITCH APPARATUS

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2 Sheets-Sheet 1

FIG. 1

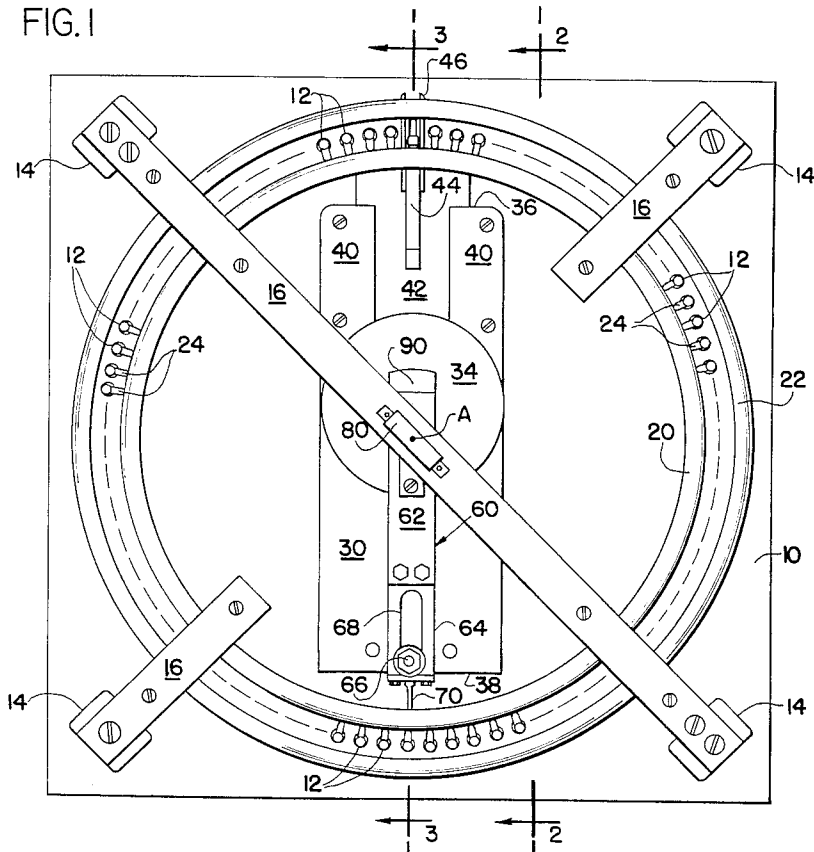
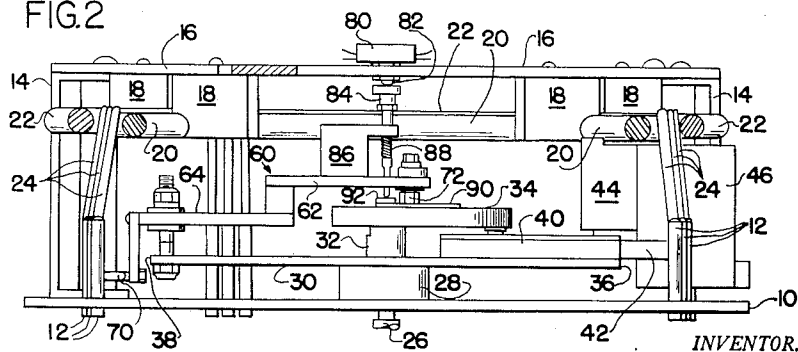


FIG. 2



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FIG.3

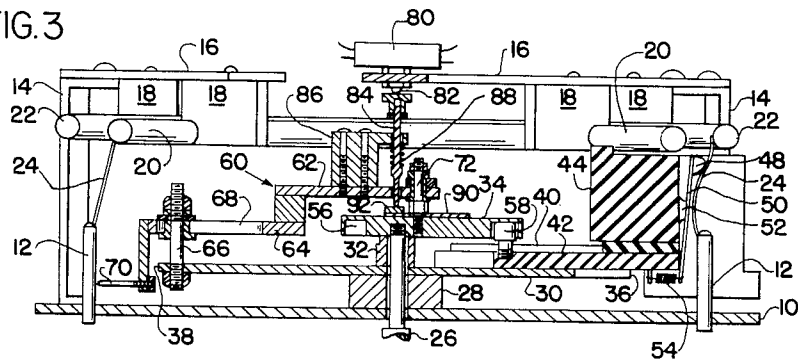
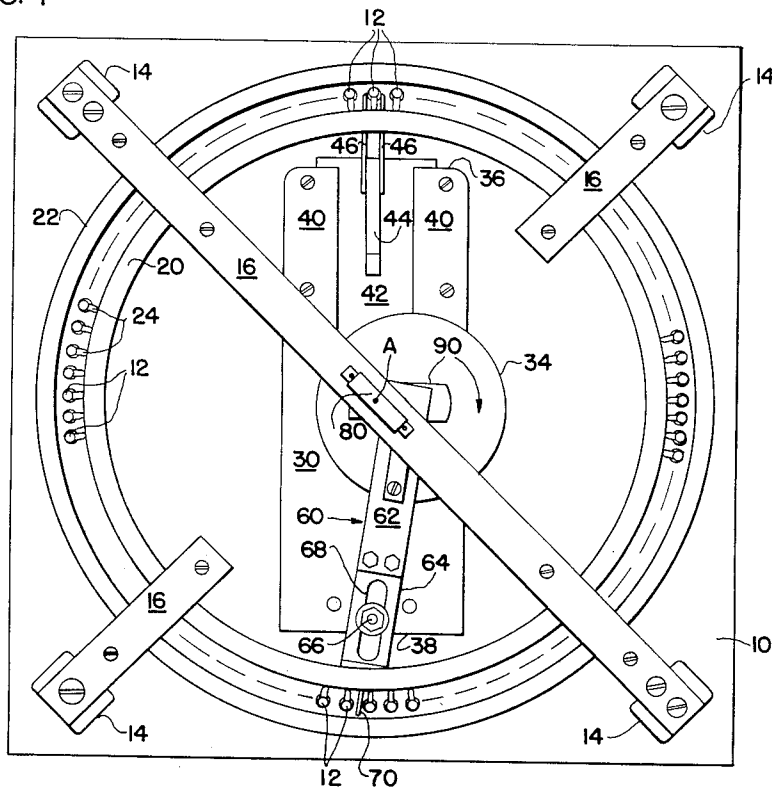


FIG.4



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3,198,921 CIRCULAR MULTIPLE CONTACT INDEXING SWITCH APPARATUS

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9 Claims. (Cl. 200—153)

This invention relates to electrical switch apparatus and, more specifically, to an apparatus that will operate automatically to actuate a series of switches in sequence.

In general terms, the apparatus includes a base which supports an annular series of evenly spaced electrical terminal posts having switch arms connected thereto. These arms normally engage a contact ring which is supported in coaxial relationship with the series of posts, but in the switching operation the arms are to be shifted in sequence from the one contact ring to a concentric contact ring and then back again. To accomplish this, a rotatable plate is supported within the annular series of posts and it has a slide on it that will move radially outwardly and inwardly while engaging the switch arm on each terminal post in sequence to effect the switching operation in one cycle of reciprocation of the slide. The plate is indexed in movement from post to post around the annular series by means of an indexing finger which can be inserted between adjacent posts in generally diametrically opposed relationship to the terminal posts being switched. A drive means is included to insert the indexing finger between the adjacent posts in the series, and this drive means serves to retract the slide while the plate is being indexed and to extend the slide for a switching operation while the indexing finger is being shifted from one space to the next space.

While use of the apparatus of this invention is not limited thereto, it has been found that it can be used to great advantage as a test apparatus for testing the conductivity of the several conductors of an electrical cable. When used in such connection, the several conductors are connected to the several terminal posts and then the terminal posts switch arms are moved from one contact ring to another, the latter contact ring being connected to a source of electrical energy in a circuit which includes a voltmeter so that the electrical connection and conductivity of the cable conductors can be tested individually and in sequence.

It is the general object of the invention to provide a simple and economical switching apparatus that is capable of substantially foolproof automatic operation in performing a series of switching operations in sequence.

The drawings show a preferred embodiment of the invention and such embodiment will be described, but it will be understood that various changes may be made from the construction disclosed, and that the drawings and description are not to be construed as defining or limiting the scope of the invention, the claims forming a part of this specification being relied upon for that purpose.

Of the drawings:

FIG. 1 is a top plan view of the presently preferred embodiment of switch apparatus constructed in accordance with the present invention;

FIG. 2 is a vertical cross sectional view of the apparatus taken as indicated generally by the line 2—2 of FIG. 1;

FIG. 3 is a further vertical cross sectional view taken generally as indicated by the line 3—3 of FIG. 1; and

FIG. 4 is a top plan view similar to FIG. 1 but showing the indexing arm in a rotated position.

With more specific reference to the drawings, it will be observed that the apparatus includes a base 10 in the form of a rectangular plate which is shown in a horizontal position but which can be supported vertically or in any other desired position. This base supports an annular series of

vertical terminal posts 12, 12 which are evenly spaced apart throughout, the series preferably being located on the base plate 10 so that its center substantially coincides with the center of the plate. Preferably, the terminal posts are provided in the form of jacks adapted to receive plugs at the bottom of the base plate 10, the plugs being connected to electrical conductors.

Upstanding legs 14, 14 are mounted on the plate 10 in circumaxially spaced relationship around the annular series of terminal posts, and at their tops these legs secure horizontal radially inwardly extending brackets 16, 16 one of which extends across a pair of diametrically opposed support or mounting legs 14, 14. Vertical plates 18, 18 are secured to depend from the brackets 16, 16, and these plates are made of insulating material and are adapted to support a pair of coaxial contact rings comprising an inner ring 20 and an outer ring 22. It should be noted that the rings 20 and 22 are supported above the annular series of terminal posts 12, 12 and substantially in coaxial relationship therewith. These rings are provided to be engaged by switch arms 24, 24 which are respectively connected with the terminal posts 12, 12 and which comprise spring-like members biased so that they will normally engage and make electrical contact with the inner contact ring 20. In the switching operation which is to be described, each of the switch arms 24 is moved in its turn from engagement with the inner contact ring 20 into engagement with the outer contact ring 22 and then back to its normal position.

The switch actuating and operating means includes a vertically extending shaft 26 (FIGS. 2 and 3) which is connected to an electric drive motor (not shown) and rotatably supported in the base plate 10 so as to project upwardly in coaxial relationship with the annular series of terminal posts 12, 12 and the contact rings 20 and 22. The axis of the shaft and common axis of the posts and rings is indicated at the point A in FIGS. 1 and 4. The said shaft extends upwardly from the base plate 10 through a bearing and spacer block 28, a plate 30, and through a collar 32 so that its projecting upper end can be threaded into a crank means 34. The construction and purpose of the crank means 34 will be described later, attention being directed now to the plate 30 which may be referred to hereinafter as support means or as an indexing plate.

The said indexing plate 30 is freely rotatable about the shaft 26 on the axis A, and it will be seen that the said plate has two ends 36 and 38 which extend radially of the shaft toward different sections of the annular series of terminal posts. Preferably, the plate 30 is of generally rectangular configuration so that its ends 36 and 38 will extend in diametrically opposite directions toward the terminal posts. At one end, the end 36, a pair of slide gibs 40, 40 are mounted on the plate 30 so that the said plate will support a slide 42 for radial reciprocation.

The slide 42 may be referred to as a switch actuating means and is made of electrical insulating material and so is a vertical radial plate 44 which is mounted on the slide near its radially outer end. Rigid insulating sheets 46, 46 are secured to the respective sides of the plate 44 so that as the slide 42 is projected radially outwardly, the said sheets will be thrust into the spaces on opposite sides of a terminal post 12. This will electrically isolate the said terminal post from those adjacent to it. At the same time, an insulated nose piece 48 will be moved by the slide into engagement with the switch arm 24 carried by the said single terminal post 12 to move it from engagement with the inner contact ring 20 into engagement with the outer contact ring 22 as shown in FIG. 3. The nose piece 48 is located at the upper end of an arm 50 which is pivoted between its ends on a post 52 and biased by a spring 54 connected to the bottom surface of the

slide 42 to project the nose piece 43 outwardly. It will be readily understood that when the slide 42 is retracted radially inwardly, the spring member switch arm 24 returns to its normal position in engagement with the inner contact ring 20.

The slide is reciprocated radially outwardly and inwardly by the eccentric means 34 with which it is connected. The said eccentric means comprises a circular disk connected to the upper end of the shaft 26 in an eccentric relationship, and it has an annular groove on its bottom face adjacent its periphery which receives a roller cam follower 58 connected to the radially inner end of the slide 42. Thus, as the disk 34 is revolved during rotation of the shaft 26, it cams the slide radially outwardly and inwardly. Obviously, while the slide is projected outwardly the insulating side sheets 46, 46 are inserted in the spaces on each side of the terminal posts and switch arm being acted upon and these side sheets will engage the said terminal post to prevent rotative movement of the indexing plate 30 until the slide 42 has been fully retracted. After one terminal post and its switch arm have been acted upon, the index plate 30 is to be rotated to an indexed position wherein the slide will engage and work upon the next adjacent post and switch arm. The means for indexing the plate 30 into rotated positions includes an indexing arm indicated generally by the reference number 60 which will now be described.

As best shown in FIGS. 2 and 3, the indexing arm 60 includes an inner section 62 and outer section 64 which are connected together to extend generally radially outwardly from the center of the apparatus. The arm 60 is pivotally and slidably connected to the other end (the end 38) of the plate 30 from the end which supports the slide 42. The pivotal and slidable connection is effected by means of a bolt 66 extending upwardly from the said other end of the plate 30 into a slot 68 provided in the outer end section 64 of the arm 60. An indexing finger 70 is supported by and in depending relationship to the outer end of the arm 60 and the said finger projects radially outwardly. Thus, as the radially inner end of the arm 60 travels in a circle around the axis A, the said arm will pivot about and slide along the bolt 66 and in so doing the index finger 70 will be projected in the space between adjacent posts 12, 12 that are generally diametrically opposed to the post being acted upon by the slide 42 to shift its switch arm.

A pivotal connection is provided on the inner end of the arm 60 by a pivot bolt 72 that extends upwardly from the eccentric disk 34 in radially spaced relationship with the axis A of the shaft 26. Therefore, when the shaft 26 is rotated, the radially inner end of the arm 60 will travel in a circular path around the axis of the shaft to obtain the aforescribed motion of the arm 60. The pivot bolt 72 is so located on the disk 34 that the arm 60 will be projected to the full extent radially outwardly and in a truly radial direction from the axis A when the slide 42 is fully retracted. Furthermore, when the slide 42 is fully extended radially outwardly, the arm 60 will occupy a truly radial position and be fully retracted inwardly, this being the position shown in FIG. 1. In such position, the index plate 30 is held in the position shown by reason of the engagement of the slide with the terminal post upon which it is acting.

At an intermediate rotated position of the shaft as shown in FIG. 4, the arm 60 will be angularly disposed with respect to a true radial line to project the index finger 70 between adjacent terminal posts. In continued rotation of the shaft and eccentric disk 34, the slide 42 will be fully withdrawn from contact with a terminal post, and such rotative movement of the shaft and disk will cause the plate 30 to be indexed (clockwise as viewed in FIG. 4) to a position wherein the slide 42 will engage and operate upon the terminal next in adjacency in a clockwise direction. Continued rotation of

the shaft will cause the index plate to be moved in step-by-step increments around the whole annular series of terminal posts. That is, for each complete rotation of the shaft 26 and the eccentric disk 34, the slide 42 is moved from operative relationship from one terminal post to operative relationship to the next adjacent terminal post. When the shaft and disk have been rotated a sufficient number of times, all of the terminal posts will be operated upon to shift their respective switch arms.

In many uses of the aforescribed apparatus, it may be desirable to have means incorporated in the construction to complete a circuit which includes the outer contact ring 22 only after and while a switch arm 24 is engaged therewith. For example, in testing each of the several conductors in an electrical cable, the test circuit might include a high voltage source of energy connected with the outer contact ring 22 and connectible selectively with each of the cable conductors which are connected in parallel with the various terminal posts 12, 12. Desirably, a switch means could be included in such a circuit and would be arranged to be normally open and to be closed only while a terminal post switch arm 24 engages the test ring 22.

Such a normally open switch means is indicated generally by the reference number 80 in the various views of the drawings. This switch may be of conventional commercially available construction and preferably it includes a plunger 82 which will close the said switch means and complete the circuit when it is depressed. The preferred switch is mounted on the support 16 which spans the contact rings 20 and 22 so that its plunger 82 projects therebelow. A vertically disposed actuator 84 is mounted on a bracket 86 secured to the inner section 62 of the arm 60 and it is biased downwardly by a spring 88 so that its lower end engages and rides upon the eccentric disk 34 or upon a wear plate 90 provided thereon. A cam shoe 92 is located on the disk 34 or upon the wear plate 90 in a rotated position thereon so that it will engage and elevate the switch actuator 84 in only that position of the eccentric disk 34 wherein the slide 42 is radially outwardly extended and wherein the index arm 60 is in a radially retracted position. In this position of the aforesaid elements, a switch arm 24 will be engaged with the outer contact ring 22. Thus, during each revolution of the shaft and eccentric disk, the switch 80 will be closed one time, this occurring when it is desirable to energize the power circuit including the contact ring 22.

The invention claimed is:

1. Electrical switch apparatus comprising an evenly spaced annular series of terminal posts, a pair of contact rings supported coaxially with the annular series of posts, switch arms respectively connected with the posts and normally engaging one contact ring, a driven shaft supported coaxially with the rings, a plate supported for rotation on the shaft axis and having two ends which extend radially toward different sections of the annular series of posts, a slide supported on one end of the plate which is reciprocable radially of the shaft to engage and move a switch arm from said one contact ring to the other and back while holding the plate in a rotated position, a generally radially extending arm pivotally and slidably connected between its ends to the other end of the plate and having an index finger on its outer end insertable between adjacent posts to fix a rotated position of the plate, crank means connecting said shaft and the inner end of the arm to insert said index finger sequentially in the spaces separating adjacent posts during rotation of the shaft and thereby to index the plate around the annular series of posts, and means interconnecting the crank means and slide to reciprocate the slide during each rotation of the shaft and thereby to sequentially move the series of switch arms as described in the sequential indexed positions of the plate.

2. Electrical switch apparatus as set forth in claim 1 including control switch means operable in one rotated

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position of the shaft to complete an electric circuit including said other contact ring when a switch arm is engaged therewith.

3. Electrical switch apparatus as set forth in claim 1 wherein the crank means comprises a disk eccentrically connected to the shaft and pivotally connected to the inner end of the said arm, and wherein the means interconnecting the crank means and the slide comprises a follower roller on the slide engaged in an annular tract on the disk.

4. Electrical switch apparatus as defined in claim 3 including normally open control switch means operable when closed to complete an electric circuit including said other contact ring, an actuator for closing said control switch, and means on said disk for operating said actuator in only one rotated position of the disk which occurs when said slide has engaged a switch arm with said other contact ring.

5. Electrical switch apparatus comprising an evenly spaced annular series of terminal posts, a pair of contact rings supported coaxially with the annular series of posts, switch arms respectively connected with the posts and normally engaging one contact ring, a driven shaft supported coaxially with the rings, a plate extending diametrically of the series of posts and supported for rotation on the shaft axis, said plate having a slide at one end which is reciprocable radially of the shaft to engage and move a switch arm from said one contact ring to the other and back while holding the said plate in a rotated position, a generally radially extending arm pivotally and slidably connected between its ends to the other end of the plate and having an index finger on its outer end insertable between adjacent posts to fix the rotated position of the plate, crank means connecting said shaft and the inner end of the arm to insert said index finger sequentially in the spaces separating adjacent posts during rotation of the shaft and thereby to index the plate around the annular series of posts, and means interconnecting said crank means and slide to reciprocate the slide during each rotation of the shaft and thereby to sequentially move the series of switch arms as described in the sequential indexed positions of the plate.

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6. Electrical switch apparatus as set forth in claim 5 including control switch means operable in one rotated position of the shaft to complete an electric circuit including said other contact ring when a switch arm is engaged therewith.

7. Electrical switch apparatus as set forth in claim 5 wherein the crank means comprises a disk eccentrically connected to the shaft and pivotally connected to the inner end of the said arm, and wherein the means interconnecting the crank means and the slide comprises a follower roller on the slide engaged in an annular track on the disk.

8. Electrical switch apparatus as defined in claim 7 including normally open control switch means operable when closed to complete an electric circuit including said other contact ring, an actuator for closing said control switch, and means on said disk for operating said actuator in only one rotated position of the disk which occurs when said slide has engaged a switch arm with said other contact ring.

9. Electrical switch apparatus comprising an annular series of spaced terminal posts each having a switch arm movable radially of the series of terminal posts and biased radially inwardly, an inner contact ring normally engaged by the switch arms and a coaxial outer contact ring engageable by said switch arms, support means rotatable on the center of said series of terminal posts, radially reciprocable switch actuating means mounted on said support means to engage and move radially outwardly said switch arm to switch it from the inner to the outer contact ring, movable indexing means mounted on said support means to cooperate with the series of terminal posts, and driven crank means interconnecting said switch actuating means and said indexing means to move each switch arm in sequence from said inner ring to said outer ring and back.

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