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a part interest

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[54] **ELECTRICAL WAFER SWITCH ASSEMBLY WITH IMPROVED ROTOR CONTACT STRUCTURE**
10 Claims, 8 Drawing Figs.
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200/166 PC
[51] Int. Cl. **H01h 1/22,**
H01h 19/58
[50] Field of Search 200/11, 166
C, 166 CP, 11 D

ABSTRACT: An electrical switch of the rotary wafer type which permits interruptions and measuring the circuit conditions in any selected one of a plurality of continuously running circuits.

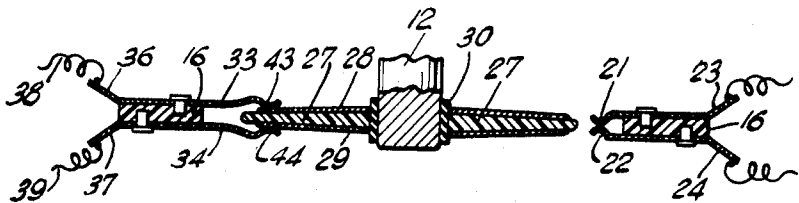


Fig. 1.

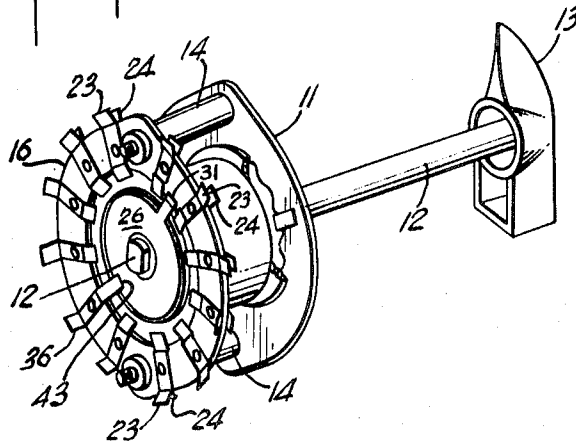


Fig. 2.

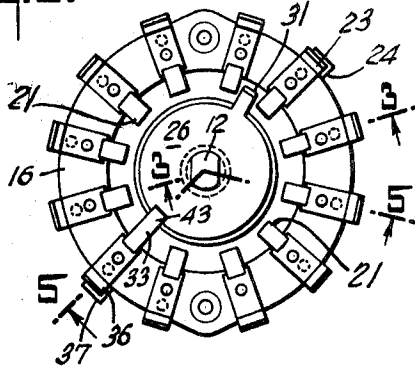


Fig. 3.

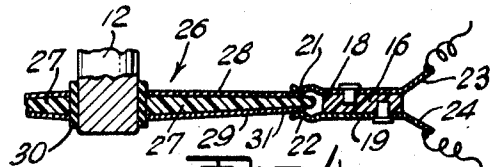
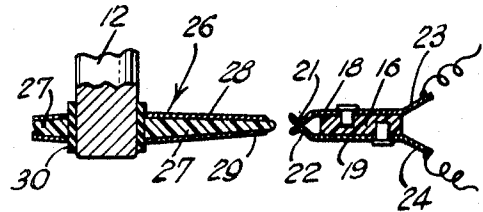


Fig. 5.

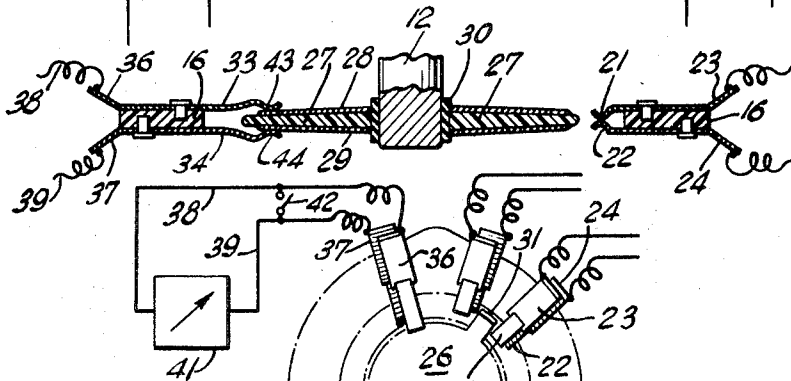
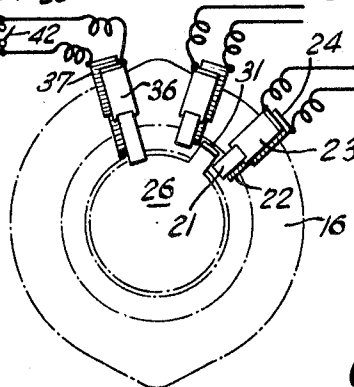


Fig. 4.

Fig. 6.



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ELECTRICAL WAFER SWITCH ASSEMBLY WITH IMPROVED ROTOR CONTACT STRUCTURE

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to switches of the rotary wafer type and, more particularly to a switch which enables the operator to measure the electrical conditions obtaining in any selected one of a plurality of continuously operating electrical circuits. The object of the invention is to connect a large number of running circuits to be measured to a single-deck or single-wafer stator of a rotary switch whereby the operation of a single rotor relative to said stator enables the operator to measure the electrical conditions in any selected one of the several circuits connected to the stator.

2. Description of the prior Art

The prior art of which applicant is aware comprises the following U.S. Pat. Nos. 2,128,279; 2,423,152; 2,828,393; 3,268,674 and 3,425,122.

Although rotary wafer switches are generally well known in the art, any attempt to perform the functions required by applicant's invention would involve the fabrication of a rotary switch having a plurality of decks or wafers which not only would be costly to manufacture but also would occupy a large amount of space. According to structures of prior art switches where it is desired to measure circuit conditions in six separate circuits, for example, and where each rotatable rotor is provided with two poles, it would be necessary to provide six decks or wafer sections as well as six respective rotors with 12 contact terminals on each deck, thereby totaling 12 poles and 72 contacts. Such a switch with six decks occupies a considerable amount of space and is fairly costly. If 12 operating electrical circuits, for example, were to be separately checked for current conditions therein, it would require a switch of 24 poles and 288 contacts. Even if such a switch were custom made at great cost, it would not be practicable to wire and handle since it would be four times as long as a six-wafer switch.

By means of the improvements disclosed and claimed herein, it is possible to connect 12 operating circuits to a single stationary stator and to select any one of said circuits for measuring by means of a single wiper on the rotor which makes electrical contact with the terminals of a selected circuit on the stator. Thus, the structure of the present invention is far less expensive to manufacture, much easier to connect to a plurality of separate circuits and, occupies a minimal amount of space on a control panel, test rack, fixture, or test jig, wherever there is need to check the voltage, current, or waveshape of any one of a large number of operating electrical or electronic circuits.

SUMMARY OF THE INVENTION

In order to obviate and overcome the shortcomings of prior art devices, the present invention comprises a single-deck rotary wafer switch stator of insulating material to which is connected a plurality of radially spaced-apart pairs of separable terminals, each said pairs of terminals being connectable to an electrical or electronic circuit to be measured. Each pair of terminals extends inwardly from the stator and the terminals of each pair on opposite sides of said stator are biased toward each other for continuously maintaining the electrical circuit closed so that each of the circuits to be measured continues to operate without interruption while other circuits are selectively measured. The single rotor operating coaxially within the central aperture of the stator has a wiper that is selectively moved into position between a selected pair of circuit terminals whereby separate electrically conductive films or plates on opposite sides of said rotor connect the selected circuit to be measured to a single pair of electrical conductors continuously in contact with the respective conductive plates on the rotor. The conductor terminals, in turn, are connected to an electrical or electronic measuring instrument which may comprise an ammeter, a voltmeter, or a cathode-ray tube

oscilloscope for displaying the waveshapes of the electrical conditions obtaining in the circuit selected by the rotor finger. While the electrical conditions in a particular selected circuit are being measured by the electrical measuring instrument, the other circuits connected to the stator of the switch continue to remain closed and in operating condition.

These and other novel features and advantages of the present invention will be described and defined in the following specification and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a switch embodying the present invention;

FIG. 2 is a top view of a stationary wafer supporting a plurality of pairs of circuit terminals and a concentric rotatable wafer including the selective circuit opener for said respective pairs of circuit terminals;

FIG. 3 is a greatly enlarged fragmentary view taken on line 3—3 of FIG. 2;

FIG. 4 is a view similar to FIG. 3 with the rotatable wafer in position where in the circuit-opening finger is performing its function in conjunction with a selected pair of circuit terminals;

FIG. 5 is a view taken on line 5—5 of FIG. 3;

FIG. 6 is a diagrammatic view of a portion of the switch indicating the manner in which a current meter is connected to the switch of the present invention, the paired circuit terminals on opposite sides of the stationary wafer being shown in staggered array or sake of clarity;

FIG. 7 is a plan view of another embodiment of the invention; and

FIG. 8 is a section view taken on line 8—8 of FIG. 7.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawing in detail, there is shown in FIG. 1 a typical switch comprising a mounting plate 11 which is adapted to be secured firmly onto the frame or chassis of an electrical apparatus operated by said switch. Mounted axially in plate 11 is a rotatable shaft 12 to the outer end of which is connected a switch knob 13 for manual rotation thereof.

Incorporated on or associated with mounting plate 11 are various indexing and stop elements which are well known in the art for releasably or yieldably securing shaft 12 in any one of a number of radially indexed positions by means of ball detents, spring elements, or the like, not shown.

Connected to mounting plate 11 by means of a plurality of circumferentially spaced-apart rigid posts 14 longitudinally and substantially parallel to shaft 12 is a flat, stationary ring-shaped stator 16 made of a suitable insulating material. Mounted on stator 16 is a plurality of radially spaced-apart pairs of circuit terminals, each of said circuit terminals comprising a first electrically conductive terminal element 18 on one side of said stator, and a second electrically conductive terminal element 19 on the other side of said stator. Terminal elements 18 and 19 extend inwardly into the circular space inside said stator and terminate in integrally formed spring-biased fingers 21, 22, respectively, which are normally in contact with each other to maintain the electrical circuit closed therebetween. The outer portion of terminal elements 18 and 19 extend outwardly from stator 16 in the form of integrally formed terminal lugs 23 and 24, respectively, which are connected electrically to the respective ends of a corresponding circuit whose current is to be measured by the apparatus herein.

Mounted axially on shaft 12 and rotated thereby within the central aperture of stator 16 is a wafer rotor, generally designated 26, which comprises a disclike core 27 made of a suitable insulating material. The opposite flat surfaces of core 27 are coated with electrically conductive films 28, and 29, respectively, the peripheral edges of said films extending to within a short distance from the peripheral edge of core 27, as shown in FIGS. 3, 4 and 5, so that said films are normally elec-

trically isolated from each other. Rotor 26 is coaxial with and aligned in substantially the same plane as stationary stator 16. Interposed between rotor 26 and shaft 12 is a bushing 30 made of suitable insulating material.

The outer peripheral edge of rotatable wafer 26 is spaced apart from the inner peripheral edge of stationary wafer stator 16 and is also spaced apart from the inner portions of fingers 21 and 22 of respective circuit terminal elements 18 and 19.

Integrally formed on the periphery of core 27 of rotor 26 is an outwardly extending wiper 31 of the same insulating material, said wiper also being coated on both of its flat surfaces with suitable extensions of electrically conductive films 28 and 29, which terminate a short distance from the end of said wiper whereby said films are normally electrically isolated from each other. Wiper 31 is movable rotatably with rotor 26 and as knob 13 and shaft 12 are rotated to desired indexed positions, said wiper enters between and urges apart a selected pair of fingers 21 and 22 of a respective pair of terminal elements 18 and 19 leading to a selected circuit whose current is to be measured.

Mounted at a suitable location on opposite surfaces of stator 16 is a pair of electrically conductive meter terminal elements 33 and 34 which have outwardly extending, integrally formed terminal lugs 36, and 27, respectively, which, in turn, are connected by suitable lead lines 38 and 39 to a current meter 41. See FIGS. 2, 5 and 6.

Meter terminals 33 and 34 have inwardly extending integrally formed spring-biased lips 43, 44, respectively, which extend across the space between stator 16 and rotor 26 and continuously impinge upon conductive films 28 and 29, respectively, on core 27, thereby maintaining meter 41 continuously in circuit with said films. When wiper 31 is located out of contact with all of the pairs of fingers 21 and 22 of respective circuit terminals 18 and 19, meter 41 will register a zero current. When rotor 26 is rotated to cause wiper 31 to become interposed between any one of the pairs of fingers 21 and 22 of a particular pair of circuit terminals 18 and 19, meter 41 will register the current flowing through the circuit connected to the pair of terminal lugs 23 and 24.

OPERATION

Each pair of lugs 23 and 24 of circuit terminals 18 and 19 mounted on stator 16 is connected by suitable leadlines to a particular circuit which is normally electrically closed and is continually in operation by virtue of a normal closure between the respective pair of fingers 21 and 22 as shown in FIG. 3. Thus, a plurality of running-closed electrical circuits can be attached to the switch herein and again continue to operate undisturbed. When it is desired to test the operating current of any selected one of said circuits, knob 13 is rotated to cause rotor 26 to rotate, thereby bringing wiper 31 into a position to urge a particular selected set of fingers 21 and 22 apart, said fingers then connecting the running circuit by way of conductive films 28 and 29 and through lips 43 and 44 of meter terminals 33 and 34, respectively, of the meter circuit, at which time meter 41 registers on its dial the current flowing through the selected circuit.

It will be noted that the single wiper 31 having separate conductive films or plates 28 and 29 on opposite sides thereof performs the function of a double-pole switch thereby accounting for the achievement of the great simplification in structure and function realized by the present invention. This single wiper 31 readily opens a selected circuit by urging apart lips 21 and 22 without causing any interruption in the operation of the circuit selected to be tested or measured and simultaneously connects said circuit by way of continuously contacting meter terminal lips 43 and 44 to the measuring instrument 41.

In some embodiments, box 41 shown in FIG. 5 may represent a voltage meter for measuring the voltage of a selected circuit, or it may represent a cathode-ray oscilloscope or the like for indicating and measuring the waveshape of the voltage or current flowing through a selected circuit. Other

suitable electrical measuring instruments may be substituted in box 41 of FIG. 5 as may be required or desired. In some applications, where it is desired or required, an on/off switch 42 may be connected across leadlines 38 and 39 to protect the instrument represented by box 41 from undue or accidental current surges, or when said instrument is to be maintained in an open circuit condition while the wiper 31 is moved through and past several pairs of fingers 21 and 22.

The switch of the present invention can also be adapted for balancing push-pull circuits and for testing stereophonic or stereo-oriented multiple-channel circuits by segmenting the switch into two, three, or more multiple units as exemplified in FIG. 7, the basic structure of which is similar to that shown in FIGS. 2-6 except for the provision of segmented electrically conductive films 28a and 28b on one side of core 27a and correspondingly segmented electrically conductive films 29a and 29b on the other side of core 27.

In these embodiments, segmented films, 28a-28b and 29a-29 are substantially semicircular in contour. Core 27a has two oppositely extending wipers 31a and 31b comparable to wiper 31 in FIGS. 1-5. Wiper 31a is coated with electrically conductive film 28a on one side and 29a on the other side, while wiper 31b is coated with electrically conductive film 28b on one side and 29b on the other side.

Mounted on ring 16a are two groups of spaced-apart paired terminal elements 18a-19a and 18b-19b which terminate, respectively, in spring-biased fingers 21a-22a and 21b-22b. Suitable indexing and stop means well known in the art are provided on shaft 12a to limit rotation of core 27a in either direction to slightly less than 180°. Mounted on ring 16a and spaced approximately 180° apart from each other are test instrument terminal elements 33a-34a and 33b-34b which terminate, respectively, in inwardly extending spring-biased lips 43a-44a and 43b-44b. Lips 43a-44a continuously impinge upon conductive films 28a and 29a respectively, while lips 43b and 44b continuously impinge upon conductive films 28b and 29b respectively. Terminal elements 33a and 34a are connected to a test instrument 41a while meter terminal elements 33b and 34b are connected to test instrument 41b.

It is understood that similar electrical circuits in each of the two channels will be connected in the same rotational sequence in which terminals 18a-19a and 18b-19b are arrayed. Thus, when wipers 31a and 31b each engage a selected pair of fingers 21a-22a and 21b-22b respectively, the same comparable component circuit in each of the two channels will be measured to tested simultaneously.

In the arrangement of the switch shown in FIGS. 7 and 8, it is apparent that the two counterpart groups of circuits such as contained in separate channels of a stereo radio receiver or phonograph can be tested for matching characteristics by connecting the circuits of one channel of the stereo apparatus to respective paired terminal elements 18a-19a and the circuits of the other channel of the stereo apparatus to respective paired terminal elements 18b-19b. Thus, the outputs of both of the stereo channels may be viewed on separate oscilloscopes or decibel meters or measured simultaneously, such as by separate ammeters or wattmeters 41a and 41b respectively.

It is contemplated that the switch of the present invention can be further segmented into three or more divisions whereby the outputs of three or more channels may be measured simultaneously. This can be accomplished by dividing the electrically conductive films 28 and 29 on core 27 into three segments of slightly less than 120° with a separate finger 31 and an additional separate measuring instrument being provided for each of the segments. Further segmentation into sections of slightly less than 90° with the provision of separate fingers 31 and separate instruments 41 for each of the segments will serve to test or measure the outputs for four channels. The limit of segmentation for measuring the circuits of greater numbers of channels simultaneously will be limited only by consideration of sizes of the switch and the requirements of the art.

It is further contemplated that the concept of the present invention can be embodied in a switch where the circuit terminals 18 and 19 are positioned in a linear spaced-apart array upon a longitudinal stationary element, while wiper 31 is mounted on a straight-line slider for rectilinear movement in relation to said circuit terminals, said wiper being part of a movable body which has the equivalent of electroconductive films 28 and 29 thereon that are continually in contact with a pair of stationary terminals comparable to elements 33 and 34 (FIG. 5) which, in turn, are connected to a test instrument 41. Here, also, the lips 21 and 22 of circuit terminals 18 and 19 will be normally closed to preserve the closed circuit condition and which are urged apart by wiper 31 for connection to the measuring instrument.

Although the present invention has been described with reference to particular embodiments and examples, it will be apparent to those skilled in the art that variations and modifications can be substituted therefor without departing from the principles and true spirit of the invention.

I claim:

1. A switch comprising a stator ring made of insulating material, a rotor made of insulating material rotatable within the central aperture of said ring and in substantially the same plane therewith, a plurality of radially spaced-apart pairs of separable circuit terminals mounted on said stator, each of said pairs of terminals being connectable to a separate electrical circuit, the respective terminals of each pair being mounted on opposite sides of said ring, an inwardly extending, integrally formed, spring-biased circuit finger on each of said circuit terminals, said fingers of each pair of terminals being normally in contact with each other to maintain the respective electrical circuit closed, each pair of circuit fingers being spaced apart from the outer periphery of said rotor, an integrally formed, outwardly extending wiper on said rotor extending into the circular path formed by the plurality of spaced-apart pairs of said circuit fingers, an electrically conductive film on each side of said rotor and extending over the corresponding respective sides of said wiper, said films being electrically isolated from each other, a single pair of meter terminals, said meter terminals being mounted on opposite sides of said stator, an inwardly extending spring-biased meter finger on each of said meter terminals, each of said meter fingers being continually urged against a respective electrically conductive film on opposite sides of said rotor, an electrical measuring instrument connected to said meter terminals, said wiper being movable upon rotation of said rotor to any one of a plurality of selected positions to urge apart a selected pair of circuit fingers whereby the selected circuit is connected by way of the electrically conductive films on said rotor through said meter terminals to said electrical measuring instrument.

2. A switch comprising a stator ring, a rotor mounted coaxially within the central aperture of said stator, a plurality of radially spaced-apart pairs of separable circuit terminals mounted on said stator, each terminal of each pair being separately connectable to respective end of a corresponding separate electrical circuit, said circuit terminals of each pair being normally biased toward each other to maintain closed the circuit to which said pair is connected, a wiper on said rotor, two separate electrically conducting elements on said rotor and said wiper, said elements being electrically isolated from each others, a pair of electrical conductors on said stator and extending upon opposite sides of said rotor and continuously in contact with respective conducting elements while said rotor is at rest and while it rotates, said pair of electrical conductors being connectable to a separate common electrical circuit, said wiper being movable when said rotor is rotated to a selected position to urge apart the terminals of a selected pair of circuit terminals to connect the selected circuit by way of said electrically conducting elements to said common circuit.

3. A switch according to claim 2 wherein said stator comprises a flat ring of insulating material and the circuit terminals of each pair of terminals are mounted on opposite sides of said

ring, and all of said pairs of circuit terminals extend inwardly into said aperture to form a circular array coaxially spaced apart from the perimeter of said rotor.

4. A switch according to claim 3 wherein said rotor comprises a disc of insulating material, said wiper extends outwardly therefrom into the circular path formed by said circuit terminals, and said two conducting elements are formed on opposite surfaces of said rotor and said wiper, said two conducting elements being electrically isolated from each other.

5. A switch according to claim 4 wherein said electrical conductors are mounted on opposite sides of said stator and extend to and impinge continuously upon respective electrically conducting elements on opposite sides of said rotor.

6. A switch according to claim 2 wherein said common circuit comprises an electrical instrument for measuring the electrical conditions obtaining within a circuit selected by said wiper.

7. A switch comprising a stator ring, a rotor mounted coaxially within the central aperture of said stator, a plurality of radially spaced-apart pairs of separable circuit terminals mounted on said stator, each terminal of each pair being separately connectable to respective ends of a separate electrical circuit, said circuit terminals of each pair being normally biased toward each other to maintain closed the circuit to which said pair is connected, a wiper on said rotor, two separate electrically conducting elements on said rotor and said wiper, said elements being electrically isolated from each other, an electrical measuring instrument, electrical conductors connecting said separate electrically conducting elements continuously to said instrument while said rotor is at rest and while it rotates, said wiper being movable when said rotor is rotated to a selected position to urge apart the terminals of a selected pair of circuit terminals to connect the selected circuit by way of said electrically conducting elements to said measuring instrument.

8. A switch comprising a stator ring, a rotor mounted coaxially within the central aperture of said stator, a plurality of radially spaced-apart pairs of separable circuit terminals mounted on said stator, each terminal of each pair being separately connectable to respective ends of a separate electrical circuit, said circuit terminals of each pair being normally biased toward each other to maintain closed the circuit to which said pair is connected, a single wiper on said rotor, two separate electrically conducting elements on said rotor and said wiper, said elements being electrically isolated from each other, an electrical measuring instrument, electrical conductors connecting said separate electrically conducting elements continuously to said instrument while said rotor is at rest and while it rotates, said wiper being movable when said rotor is rotated to a selected position to urge apart the terminals of a selected pair of circuit terminals, said circuit terminals remaining in electrical contact with respective separate electrically conducting elements on said wiper and said rotor whereby said measuring instrument is introduced into the selected electrical circuit.

9. A switch comprising a stator ring, a rotor mounted coaxially within the central aperture of said stator, a first group of a plurality of radially spaced-apart pairs of separable circuit terminals mounted on said stator, a second group of a plurality of radially spaced-apart pairs of separable circuit terminals mounted on said stator, each terminal of each pair being separately connectable to respective ends of a separate electrical circuit, said circuit terminals of each pair being normally biased toward each other to maintain closed the circuit to which said pair is connected, first and second spaced-apart wipers on said rotor, a first pair of separate electrically conducting elements insulated from each other and located on opposite sides of said rotor and said first wiper, a second pair of separate electrically conducting elements insulated from each other and located on opposite sides of said rotor and said second wiper, first and second electrical measuring instruments, electrical conductors continuously connecting said first and second instruments separately to respective first and

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second pairs of electrically conducting elements on said rotor and said respective first and second wipers while said rotor is at rest and while it rotates, said first and second wipers being movable when said rotor is rotated to selected positions to urge apart the terminals of respective selected pairs of circuit terminals in said first and second groups of circuit terminals to connect said respective circuits to said respective first and second measuring instruments.

10. A switch comprising a stator ring, a rotor mounted coaxially within the central aperture of said stator, at least two groups of a plurality of radially spaced-apart pairs of separable circuit terminals mounted on said stator, each terminal of each pair being separately connectable to respective ends of a separate electrical circuit, said circuit terminals of each pair being normally biased toward each other to maintain closed

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the circuit to which said pair is connected, a wiper on said rotor for each of said groups, each wiper engaging the circuit terminals of only a corresponding group of pairs of terminals, an electrical measuring instrument for each of said groups of circuit terminals, means connecting said instruments to respective spaced-apart pairs of terminals on said stator, and means maintaining continual electrical connection between said instrument terminals and said respective wipers while said rotor is at rest and while it rotates, said wipers being movable when said rotor is rotated to selected positions to urge apart the terminals of respective selected pairs of circuit terminals in each of said groups of circuit terminals to connect corresponding respective circuits to said respective measuring instruments.

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