Sept. 16, 1952 P. VAN S. KOLFF 2,611,051

ROTARY CONTACTOR DEVICE

Filed Oct. 4, 1951 2 SHEETS—SHEET 1

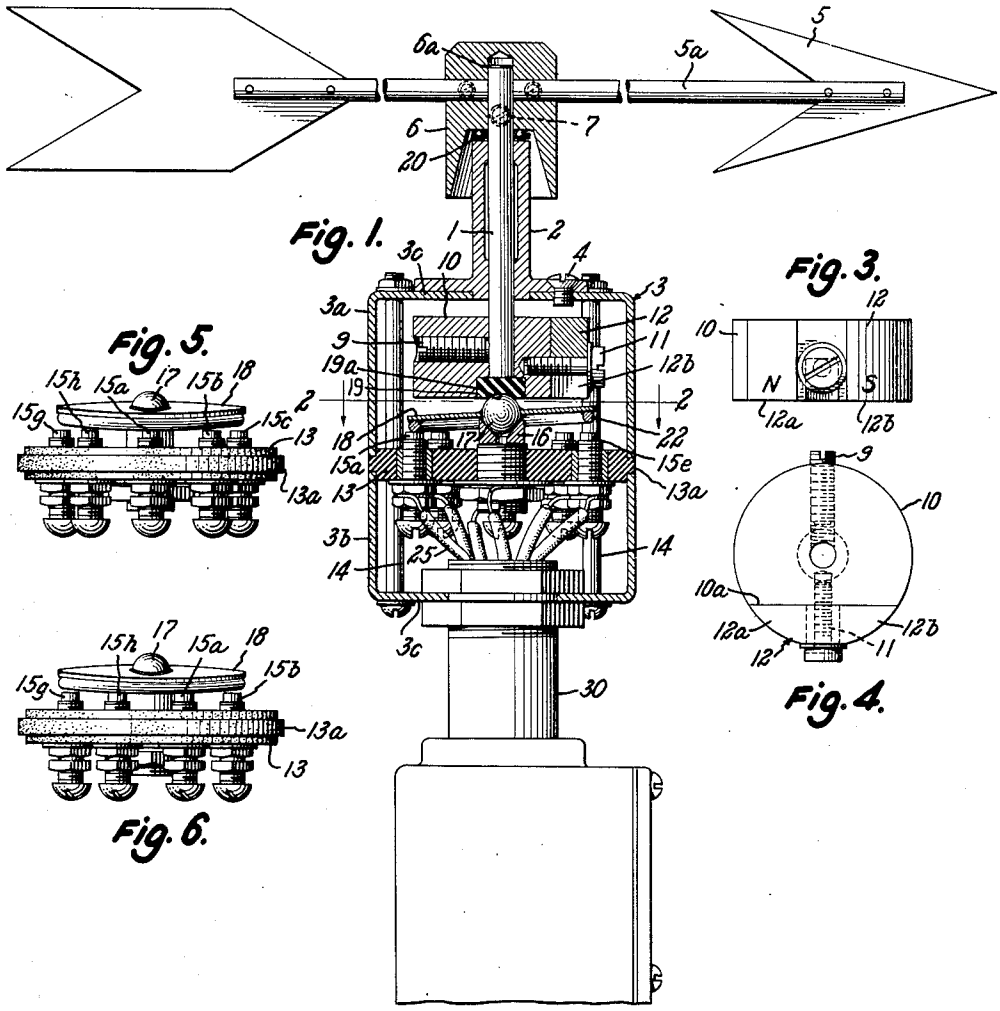


Fig. 1.

Fig. 5.

Fig. 6.

Fig. 3.

Fig. 4.

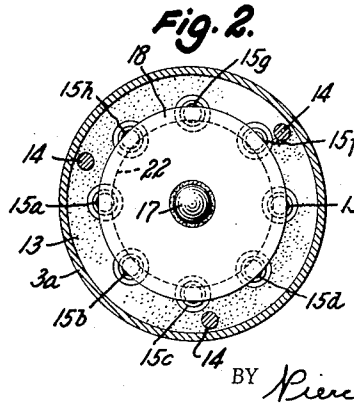


Fig. 2.

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Fig. 7.

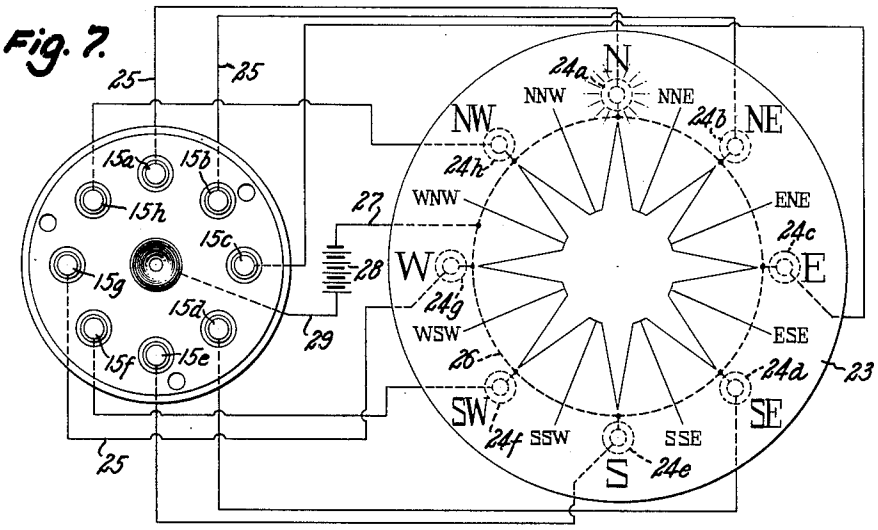


Fig. 8.

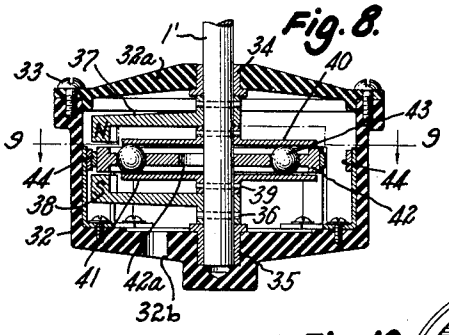


Fig. 11.

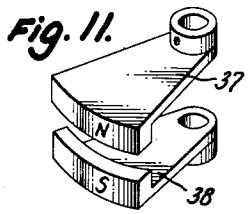


Fig. 10.

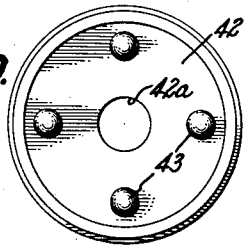
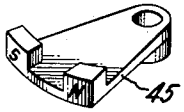


Fig. 12.



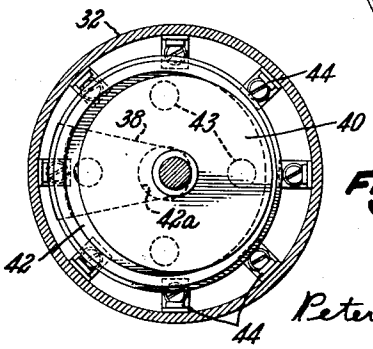


Fig. 9.

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ROTARY CONTACTOR DEVICE

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Application October 4, 1951, Serial No. 249,650

16 Claims. (Cl. 200—87)

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The present invention relates to electric switching device and in particular to an improved construction for switches of the type wherein a plurality of contacts are arranged in a contact circle and circuits therethrough are completed selectively in accordance with the angular position of a control member which is arranged for rotation about an axis coincident with the center of the contact circle.

In one well-known construction the rotary control member is comprised of a contact member which as it rotates engages the stationary contact members in succession thus establishing circuits through the rotary contact member and each of the stationary contacts in succession. If the rotary contact member rotates continuously one thus obtains periodic switching in the circuits associated respectively with the several fixed contacts such as in an ignition timer device for internal combustion engines. If the rotary contact member is associated with an angular positioning device such as a wind direction indicating vane then the circuits established respectively between the rotary contact and the circular array of fixed contacts can be used to telemeter the vane direction to a remotely disposed direction indicating instrument.

According to another well-known construction sometimes referred to as a "drunken wheel" switch the rotary contact member is constituted by a wobble plate which is made to wobble about its axis either by means of an eccentric linkage mechanism or a cam riding in frictional contact with the wobble plate to the end that the low point on the periphery of the contact plate travels progressively around a circular path to engage, in succession, the several fixed contacts which are disposed along the path.

In still another type of construction, sets of relatively movable contacts are disposed along a circular path and a magnet rotating on an axis coincident with the center of said path effects momentary closure or opening, whichever is desired, of the contacts sets in succession by its inherent attractive force on the contacts.

In all of the about types of switching devices, however, a considerable amount of torque must be available for turning the rotary contact member and in the case of the rotary magnet type, the magnet must be worked cyclically between several minimum and maximum attraction phases for each revolution which effects corresponding but undesirable changes in the loading torque.

A primary object of the present invention is to

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provide an improved construction for a rotary switch or contactor device which because of an entirely new operating principle involved can be used reliably in applications where the driving torque is of a very low order such as for example in a wind direction indicating system where the torque on the weather vane is, in the case of a feeble wind, often only a few inch-ounces. Other low-torque systems for which the switching device according to this invention can be used will be readily suggested to those familiar with the switching art.

In accordance with this invention the contactor device is characterized by a contact disc of magnetic material arranged for displacement about a central axis, a plurality of contacts arranged in spaced relation along a contact circle concentric with the central axis, and a magnet having its pole portions arranged for movement along an arcuate path concentric with the central axis adjacent a peripheral portion of the disc surface and circumferentially thereof. The magnetic attraction of the disc to the poles of the magnet is both continuous and uniform, and as the magnet poles progress along their circular path, a progressively changing portion of the disc periphery is displaced in the direction of the poles to cause a corresponding progressively changing portion of the disc periphery to engage the contacts located on the contact circle in succession.

In one embodiment of the invention which will be hereinafter described, the magnetic contact disc is mounted on a ball and socket bearing to execute a wobble motion about the central axis as the magnet is rotated, and the progressively changing low point on the disc periphery travels progressively around the contact circle.

In another embodiment also to be described the contact disc is caused to execute an oscillating motion about the central axis in a plane transverse to that axis as the magnet rotates causing a progressively changing peripheral portion of the disc to be displaced radially outward to engage the contacts on the contact circle in succession.

In the accompanying drawings which illustrate these two embodiments:

Fig. 1 is a view in vertical section of the embodiment wherein the rotating magnet element of the switching or contactor device cooperates with a contact disc of the wobbler type, the application of the switching device being to a wind direction indicator system;

Fig. 2 is a transverse section on line 2—2 of Fig. 1;

Figs. 3 and 4 are views in side elevation and top plan, respectively of the rotary magnet and its support;

Figs. 5 and 6 are views in elevation of the contact disc and the circular array of fixed contacts associated therewith showing two different positions of contact of the former on the latter;

Fig. 7 is a circuit diagram showing the rotary switching device and its connections to the repeater instrument for indicating different angular positions of the weather vane;

Fig. 8 is a view in vertical section of an embodiment of the invention wherein the contact disc whose motion is controlled by the rotating magnet is arranged for oscillatory displacement in a progressively changing radial direction towards the circular array of fixed contacts which surround the periphery of the disc;

Fig. 9 is a transverse section on line 9—9 of Fig. 8;

Fig. 10 is a plan view of the contact disc;

Fig. 11 is a perspective view of the rotary magnet used in the Fig. 8 construction; and

Fig. 12 is a view similar to Fig. 11 illustrating a modified form of magnet which can be used in lieu of the construction shown in Fig. 11.

The contactor device shown in Figs. 1–6 for transmitting angular indications is comprised of a vertical shaft 1 arranged for rotation in a bearing sleeve 2 which is arranged in an upstanding manner upon a casing 3 and secured thereto by one or more screws 4. A wind direction vane of any desired configuration but here illustrated in the form of an arrow 5 is secured to a fitting 6 having a bore 6a therein adapted to receive the upper end of shaft 1, and a set screw 7 is used to fasten the fitting 6 to the shaft 1 to prevent relative rotation therebetween. Thus as the indicator vane 5 turns with a shift in wind direction the shaft 1 will also be turned through a like angle. While the material from which the parts are made is not critical, the apparatus will be exposed to the weather and hence it is preferable to make shaft 1 and bearing sleeve 2 of bronze. Also of bronze can be the shaft 5a of the weather vane and brass can be used for the vane fitting 6. Casing 3 can be of galvanized iron or steel.

The lower end of shaft 1 extends within casing 3 and has fastened thereto by set screw 9 an arcuate block 10 of non-magnetic material such as brass. Block 10 as shown in Fig. 4 has a flat 10a along one side to which is secured by screw 11 a permanent magnet 12 having vertically depending poles 12a, 12b which travel along a circular path concentric with the axis of shaft 1.

Situated beneath the rotatable assembly consisting of vane 5, shaft 1, block 10 and magnet 12 is a circular plate 13 made from any suitable electrical insulating material having a peripheral rib portion 13a by which it is held in a horizontal position between the edges of the upper and lower halves of casing 3. The two casing halves 3a and 3b are held together by a plurality of bolts 14 which extend longitudinally through the same between the end walls 3c.

Plate 13 is arranged concentric with the axis of shaft 1 and carries a plurality of stationary contact members 15a–15h arranged in spaced relation along a contact circle also concentric with the axis of shaft 1. In the illustrated embodiment, the upper ends of these stationary contacts project above the surface of plate 13 for a reason which will be later explained, but such contacts could be arranged flush with the disc surface for certain other applications of the inventive principle herein disclosed without departing from the spirit and scope of the invention. Also carried by plate 13 and upstanding upon and concentric with the center thereof is a socket 16 which receives a ball member 17 secured to a thin circular disc 18 of magnetic material such as soft iron. In the illustrated embodiment, disc 18 is provided with a central aperture of substantially the same diameter as ball 17 and the latter is soldered to the edge of the aperture along substantially a great circle on the ball. The lower half of ball 17 thus rides in socket 16 and a portion of the upper half is adapted to contact an arcuate recess 19a provided in the underface of a block of insulating material 19 secured to the bottom face of shaft 1 to prevent any possible "grounding" of the electrical circuit. However, it is to be noted that a thrust bearing 20 placed between the confronting end faces of bearing sleeve 2 and fitting 6 carries the entire vertical loading of the rotatable assembly and hence no pressure whatsoever is placed upon ball 17 by shaft 1. In this manner disc 18 is rendered free from all loading except an inconsequential amount due to the contact pressure between the ball and socket members of the bearing for the disc attributable to the combined mass of disc and ball.

Attached to the underface of disc 18 near its periphery is contact ring 22 of copper or other good electrically conductive material. The latter is also concentric with the axis of shaft 1 and is adapted to engage the stationary contacts 15a–15h in succession as shaft 1 is rotated. If desired, however, it is also possible to omit the contact ring and have the rim of the disc engage the contact directly.

With reference now to Fig. 1, it will be seen that with the shaft 1 and magnet 12 in the angular position depicted, the right side of disc 18, being of magnetic material is tilted upward due to its magnetic attraction to the depending poles 12a, 12b. The opposite side of disc 18 is of course tilted downwardly to bring that side of contact ring 22 into engagement with the stationary contact member 15a on that side, as shown in Fig. 5. Hence as the angular position of shaft 1 and hence also magnet 12 changes, the continuous and uniform attraction between a progressively changing circumferential portion of disc 18 and the magnet poles will cause the low point of contact ring 22 to roll progressively along the circumference of the contact circle and establish contact with the contacts 15a–15h in succession.

Disregarding the magnetic forces of attraction between magnet 12 and disc 18, the latter is statically balanced to as fine a degree as is possible for all tilt angles and hence practically no work is required of the magnet to change from one tilt angle to another as shaft 1 changes its angular position. Hence a minimum of torque is required to turn shaft 1 and the wind indicator vane 5 will thus be responsive to winds of very low velocities. Also it should be noted that the attractive force between disc 18 and magnet 12 being constant, the torque required to rotate shaft 1 will likewise be constant.

Fig. 7 shows one arrangement for telemetering the angular positions of weather vane 5 to an instrument located remotely therefrom. The repeater instrument shown schematically only includes a transparent or translucent face plate 23 fashioned in the form of a stationary compass

card with the points of the compass denoted thereon in any desired manner. In the illustrated embodiment, the card consists of eight major bearing indications spaced 45° apart legended respectively N, NE, E, SE, S, SW, W and NW, and electric lamps 24*a*–24*h* are located beneath plate 23 in radial alignment respectively with the eight major bearings. Other minor bearing indications are located midway between each pair of the eight major bearings to indicate the other eight bearings such as NNE between N and NE, NNW between NW and N, etc.

The eight fixed contacts 15*a*–15*h* on plate 13 are likewise spaced 45° apart and are electrically connected by conductors 25 to one terminal of their correspondingly positioned lamps 24*a*–24*h*. The other terminals on these lamps are all connected together to ring conductor 26, conductor 27 leads from conductor 26 to one terminal of a source of power indicated by battery 28, and conductor 29 extends from the other terminal on battery 28 to the contact ring 22 via socket 16, ball 17 and disc 18, the latter three elements being also electrically conductive. As shown in Fig. 1, the conductors extending between casing 3 and the remotely located repeater instrument are carried through conduits 30.

Thus for example assuming that when the wind direction is from the north, contact ring 22 will be tilted so as to engage contact 15*a* and this will establish a circuit through battery 28 for energizing lamp 24*a* beneath the "N" designation on the compass card. In a similar manner, each of the other seven major wind directions will be made known to the observer.

Should the wind direction be from a direction midway between two of the eight major compass bearings such as "NNW" which is between "NW" and "N," then contact ring 22 will be in the position shown in Fig. 6 wherein it engages both contact 15*h* and 15*a* thus energizing two lamps 24*h* and 24*a*. With both the "N" and "NW" indicia illuminated, this indicates to the observer that the wind direction is between N and NW. The contact ring 22 is of course able to bridge simultaneously two, but not more than two, adjacently positioned contacts such as 15*h* and 15*a* because the latter project above the surface of plate 13 and hence make it possible for the low point on the ring to dip between them. For other applications which require successive but non-overlapping engagement between the disc and contact, the latter could be arranged flush with the surface of plate 13 in which case contact ring 22 would engage the contacts 15*a*–15*h* one at a time only.

Another construction wherein the magnetic attractive force acts continuously upon a progressively changing peripheral portion of a contact member is shown in Figs. 8–12 wherein the magnetic disc member, instead of undergoing a wobble motion about the central bearing axis upon rotation of the magnet as in the embodiment previously explained, is caused to execute an oscillating motion about the central axis in a plane transverse to that axis to bring a progressively changing peripheral portion of the disc into successive engagement with the contacts.

With reference now to Figs. 8–11, the angular input shaft is designated by numeral 1′ and in the interest of simplifying the drawings, the vane structure by which the shaft is rotated has been deleted. The lower part of shaft 1′ containing the contactor mechanism is enclosed by a cup shaped housing 32 preferably of insulating material having a cap 32*a* secured thereto by screws 33, and bronze bearing sleeves 34, 35 set into the body of housing 32 and cap 32*a* provide bearings for the shaft.

Mounted on the cylindrical shaft 1′ and fixed thereto by pins 36 are a pair of magnets 37, 38 extending radially of the shaft axis having unlike poles, i. e., N—S, of arcuate shape arranged in confronting spaced relation. Disposed between the magnets and likewise mounted upon and secured to shaft 1′ by pins 39 are a pair of circular guide plates 40, 41 of a wear-resistant material such as for example hard bronze. Plates 40, 41 are arranged in spaced parallel relation concentric with the axis of shaft 1′ and a disc 42 of iron or other magnetic material is disposed around the shaft between plates 40—41, the disc including a plurality of anti-friction roller means such as balls 43 mounted in apertures in the body thereof adapted to establish a rolling surface contact with plates 40, 41. Shaft 1′ extends through a central, circular aperture 42*a* in disc 42 and the diameter of the aperture is made larger than the diameter of shaft 1′ by an amount at least equal to the radial displacement of the disc 42. Preferably the diameter of aperture 42*a* is made slightly larger than the radial displacement of disc 42 to allow for contact wear.

The diameter of disc 42 is made somewhat less than the radial length of the magnets 37, 38 so that as illustrated in Fig. 8 the magnetic field between the pole portions of magnets 37, 38 will draw the disc radially to a position eccentric of the shaft axis.

Spaced in a circle surrounding the disc 42 are a plurality of fixed contact members 44 adapted to be contacted in succession by the progressively changing portion of the periphery of disc 42 which is drawn radially outward between the confronting poles of magnets 37, 38. As in the previous embodiment, eight fixed contact members spaced 45° apart around a circle concentric with the axis of shaft 1′ are used and the periphery of disc 42 will engage two adjacently positioned contact members when the radius along which the disc 42 is shifted is located midway between adjacent contact members. Leads (not shown) from the fixed contacts 44 and from the rotary shaft 1′ are taken out of the housing 32 through aperture 32*b* in the wall thereof. In this embodiment, the electrical path to disc 42 extends from the shaft 1′ through guide plates 40, 41 and balls 43, the surfaces of which are in constant contact with disc 42.

Fig. 12 illustrates an alternative form of magnet component which can be substituted in the Fig. 8 assembly for the one shown in Fig. 11. In the Fig. 8 construction, two magnets as shown in Fig. 11 are required and the flux gap between the confronting faces of the unlike poles of the magnets extends perpendicular to the plane of disc 42. In the alternative construction shown in Fig. 12, only one magnet 45 is required and the N and S poles thereof are so arranged that the flux gap between the poles extends circumferentially of the disc 42.

If it be assumed that the contactor device of Fig. 8 is operated in the upright position as illustrated, a magnet construction as shown in Fig. 12 could be substituted for the lower magnet 38, thus enabling the upper magnet 37 and upper guide plate 40 to be eliminated.

In conclusion I desire it to be understood that the embodiments of my invention which have

herein been illustrated and described are to be considered typical rather than limitative of the inventive concept to which the appended claims are directed, and hence various changes in the construction and arrangement of the essential component parts may be made without departing from the spirit and scope of the invention. As a typical example, the magnet component of the contactor device can be of the electrical type rather than the permanent type illustrated and it will also be evident that the contactor device according to the invention can be adapted to various other uses where a rotary type of switch is required.

I claim:

1. In an electrical contactor device, the combination comprising a contact disc of magnetic material mounted for displacement about a central axis, contacting means disposed along a contacting circle concentric with said axis adjacent the periphery of said disc, a rotatable magnet having the pole portions thereof arranged for movement along a circular path concentric with said axis adjacent the disc surface and circumferentially thereof, said disc being in a state of continuous attraction to said magnet poles, and means for rotating said magnet whereby to effect displacement of a progressively changing portion of the disc surface in the direction of said magnet poles and a corresponding progressive contact between the periphery of said disc and the contacting means on said contacting circle.

2. An electrical contactor device as defined in claim 1 wherein said magnet is of the permanent type.

3. In an electrical contactor device, the combination comprising a contact disc of magnetic material, mounting means for said disc adapting the same for a wobble motion about the axis of the mounting means, a plurality of contacts arranged in spaced relation along a contact circle in the path of the periphery of said disc, a magnet having the poles thereof arranged for movement along a circular path concentric with said contact circle adjacent the surface of said disc, said disc surface being in a state of continuous tilt by magnetic attraction to said magnet poles, and means for rotating said magnet thereby causing said disc to wobble on its mounting and to bring a progressively changing peripheral portion of said disc into successive engagement with said contacts.

4. An electrical contactor device as defined in claim 3 wherein said magnet is of the permanent type.

5. In an electrical contactor device, the combination comprising a contact disc of magnetic material, a ball and socket bearing for said disc located at the center thereof, a plurality of contacts arranged in spaced relation along a contact circle in the path of the periphery of said disc, and means for imparting a wobble action to said disc on said bearing to bring a progressively changing peripheral portion of said disc into successive engagement with said contacts comprising a rotatable magnet having the poles thereof arranged for movement along a circular path concentric with said contact circle adjacent the surface of said disc, said disc surface being in a state of continuous tilt by magnetic attraction to said magnet poles, and means for rotating said magnet.

6. In an electrical contactor device, the combination comprising a contact disc of magnetic material, a support plate of insulating material, a ball and socket bearing for said disc carried by said support plate, a plurality of contacts arranged on said plate in spaced relation along a contact circle concentric with the axis of said bearing, and means for imparting a wobble action to said disc on said bearing to bring a progressively changing peripheral portion of said disc into successive engagement with said contacts comprising a rotatable magnet having the poles thereof arranged for movement along a circular path concentric with said contact circle adjacent the surface of said disc, said disc surface being in a state of continuous tilt by magnetic attraction to said magnet poles, and means for rotating said magnet.

7. An electrical contactor device as defined in claim 6 wherein said contacts upstand from the surface of said plate and the periphery of said contact disc engages adjacent contacts on said contact circle when the low point on the periphery of said disc lies intermediate said adjacent contacts.

8. An electric contact device as defined in claim 6 wherein said magnet is of the permanent type.

9. An electrical contactor device as defined in claim 6 wherein said contact disc includes a contact ring constituting the peripheral portion which engages said contacts.

10. An electrical contactor device as defined in claim 6 wherein the means for rotating said magnet comprises a shaft arranged for rotation on an axis concentric with said bearing axis.

11. In an electrical contactor device, the combination comprising a contact disc of magnetic material, a support plate of insulating material, a ball and socket bearing for said disc carried by said support plate, said disc being statically balanced on said bearing, a plurality of contacts arranged on said plate in spaced relation along a contact circle concentric with the axis of said bearing, a shaft arranged for rotation on an axis coincident with the axis of said bearing, the end of said shaft including an arcuate recess confronting the surface of the ball member of said bearing opposite the socket member to prevent unseating of the same from the socket member, and means for imparting a wobble action to said disc on said bearing to bring a progressively changing peripheral portion of said disc into successive engagement with said contacts comprising a magnet mounted on said shaft for rotation therewith, the poles of said magnet being arranged to travel along a circular path concentric with said contact circle adjacent the surface of said disc, said disc surface being in a state of continuous tilt by magnetic attraction to said magnet poles.

12. In an electrical contactor device the combination comprising a circular contact disc of magnetic material arranged for oscillatory motion about a central axis in a plane transverse to such axis, a plurality of contacts arranged in spaced relation along a contact circle concentric with said axis adjacent the periphery of said disc, the radius of said contact circle being greater than that of said disc, a rotatable magnet having the pole portions thereof arranged for movement in a circular path concentric with said axis adjacent the disc surface and circumferentially thereof, the radius of the circular path of said magnet poles being greater than that of said disc, and the periphery of said disc being in a state of continuous radially outward attraction to said magnet poles eccentrically of said

axis, and means for rotating said magnet thereby to cause a progressively changing radially displaced peripheral portion of said disc to engage the contacts on said contact circle in succession.

13. An electrical contactor device as defined in claim 12 and which further includes a guide plate for said contact disc arranged in spaced parallel relation to said contact disc and roller means between said guide plate and contact disc.

14. An electrical contactor device as defined in claim 13 wherein said magnet, and guide plate are carried by a rotatable cylindrical shaft arranged coaxially with said central axis and which passes through a central circular aperture in said contact disc having a diameter greater than

that of said shaft by an amount equal to the radial displacement of said disc.

15. An electrical contactor device as defined in claim 12 wherein the unlike pole portions of said magnet present arcuate faces arranged in mutually confronting relation at the periphery of said contact disc and the gap between said pole faces extends perpendicular to the plane of the disc.

16. An electrical contactor device as defined in claim 12 wherein the unlike pole portions of said magnet are arranged to establish a gap therebetween extending parallel to the plane of the disc.

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No references cited.