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W. C. SEALEY
DIAL SWITCH WITH STATIONARY
BLADES HAVING CUTBACK EDGES
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2,662,130

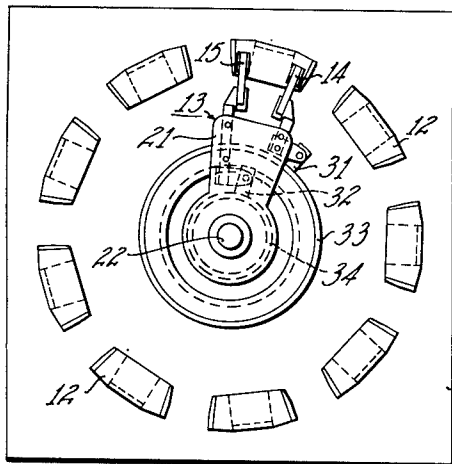


Fig. 1

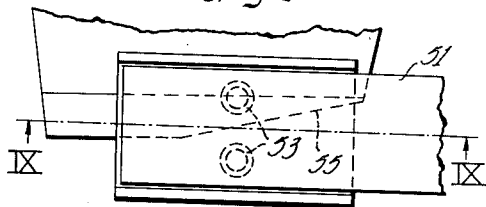


Fig. 8

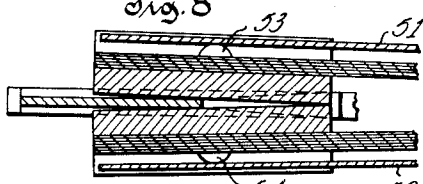


Fig. 9

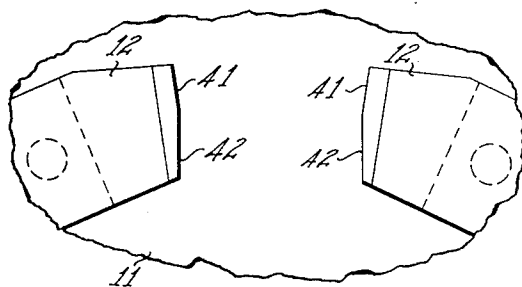


Fig. 2

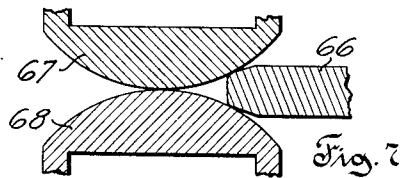


Fig. 7

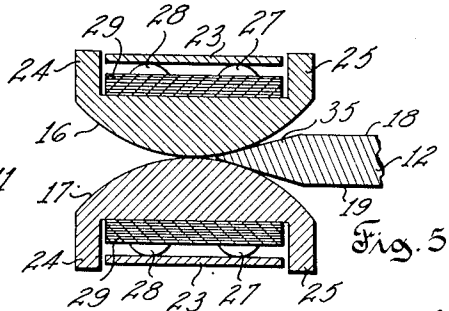


Fig. 5

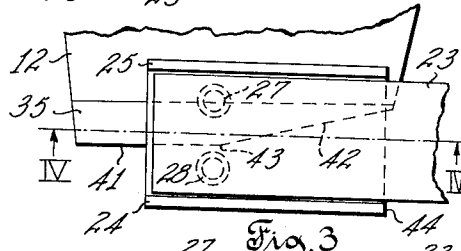


Fig. 3

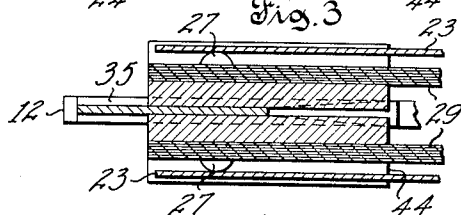


Fig. 4

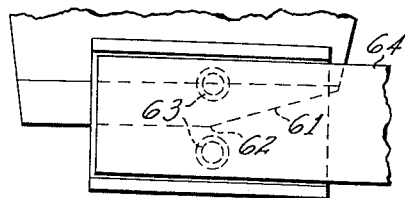


Fig. 6

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UNITED STATES PATENT OFFICE

2,662,130

DIAL SWITCH WITH STATIONARY BLADES
HAVING CUTBACK EDGESWilliam C. Sealey, Wauwatosa, Wis., assignor to
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7 Claims. (Cl. 200—11)

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This invention relates generally to dial switches and more particularly to the contact elements of such switches.

Dial switches to which this invention relates are embodied in regulating equipment of the stationary induction type in which the windings of a transformer are selectively connected to a load or a line through conventional tap changing equipment which includes the dial switch. An example of a dial switch utilized in such voltage regulating equipment is illustrated in my U. S. Patent 2,399,943 granted May 7, 1946, for an Electrical Regulating Apparatus.

It is an object of this invention to provide a dial switch in which the potential difference between adjacent fixed contact blades can be increased thereby increasing the allowable voltage between taps on the windings of the regulator in which the dial switch is embodied.

Another object of this invention is to reduce the size of dial switches by decreasing the required diameter of the circle on which the fixed contact blades are circumferentially spaced while maintaining the comparative ease of rotation of the movable shoes from one fixed blade onto the next fixed blade.

Still another object of this invention is to improve dial switches having two pairs of circumferentially spaced movable shoe contact elements that cooperate selectively either with a single fixed switch blade or with adjacent circumferentially spaced fixed switch blades, by increasing the clearance between the adjacent fixed blades and by reducing the electrical stress at the edges of the fixed blades while maintaining the comparatively long inclined edge surfaces on which the pairs of movable shoe contacts must make rubbing engagement.

And still another object of this invention is to increase the clearance between circumferentially spaced fixed blades of a dial switch without reducing the length of the upper and lower contact faces of the blades, without reducing the effectiveness of the tapered contact engaging edge portions of the blades that evenly and uniformly separate the pair of movable shoes as they move onto the blade, and without appreciably flexing the conductive shunts fastened to the movable shoes.

Objects and advantages other than those above set forth will be apparent from the following description when read in connection with accompanying drawings, in which:

Fig. 1 is a plan view of a dial switch embodying this invention;

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Fig. 2 is an enlarged partial view of two adjacent fixed blades of the switch shown in Fig. 1;

Fig. 3 is an enlarged plan view of a portion of a fixed blade and one pair of contact shoes of the rotary contact assembly of the switch of Fig. 1, with the shoes shown displaced so as to engage with the tapered edge portion of the blade;

Fig. 4 is a sectional view taken along line IV—IV of Fig. 3;

Fig. 5 is an enlarged sectional view of part of the switch of Fig. 1, with the shoes displaced to show the engagement of the curved contact surfaces of a pair of contact shoes with the tapered contact engaging edge portion of a fixed blade;

Fig. 6 is an enlarged plan view similar to Fig. 3 of a modified embodiment of the dial switch contact elements;

Fig. 7 is a sectional view showing the engagement of the contact surfaces of a pair of movable shoes and a prior art fixed blade that has a length of tapered edge portion of the blade removed for example to increase the circumferential clearance between adjacent blades;

Fig. 8 is a plan view similar to that of Fig. 3 of another embodiment of the dial switch contact elements; and

Fig. 9 is a sectional view taken along line IX—IX of Fig. 8.

The dial switch illustrated in Fig. 1 includes an insulating panel 11 on which a plurality of contact blades 12 are fixed by suitable fastening means (not shown). These blades are disposed on a circle about the center of the dial switch and are equally spaced circumferentially from each other so that one blade or two adjacent blades may be selectively engaged by a rotary contact assembly 13 having two pairs of circumferentially spaced contact shoes 14 and 15.

The contact shoes are identical to each other and the similar, oppositely disposed curved contact surfaces 16, 17 of a pair cooperate with opposite faces 18, 19 of each of the blades. Each of the contact shoes is carried by arm 21 which may be rotated about the center of the switch by shaft 22. It is desirable that considerable contact pressure be exerted on the stationary or fixed blades by the shoes so that the switch will carry heavy load currents without excessive heating of the contact elements, and this force applying means is illustrated as springs 23 which are suitably fastened at one end to the rotating arm and have their opposite ends confined between the sides 24, 25 of the trough shaped contact shoes, as can be seen in Fig. 5. Each spring

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firmly presses on rivets 27, 28 which connect the outer end of a conducting shunt 29 of thin strips of copper to the shoe. The inner end of the shunt is fastened by suitable means (not shown) to one of the brushes 31, 32 engaging collector rings 33, 34 in a well known manner.

As mentioned above, the oppositely disposed contact surfaces of the shoes are curved; preferably these are segmental cylindroidal portions that are curved in cross section normal to a radial line from the center of the dial switch. Thus, these surfaces of a pair of the shoes illustrated have contact with the stationary blades along a line radial of the center of the switch.

The circumferentially spaced end portions 35 of each of the blades are tapered from their opposite upper and lower faces 18, 19 to their median plane so as to present a gradual incline on which the shoes rub as they move onto a blade. The angle between the inclined surfaces or tapered end portions is sufficiently small to provide a uniform wedging action to force the shoes apart and to present a slight incline and minimum resistance to separation of the shoes.

In order to reduce the size of the dial switches or to increase the electrical potential difference that may be imposed between any two adjacent blades the space between the adjacent end portions of contiguous blades is increased, and in accordance with this invention that increase in clearance between adjacent blades is effected without any disadvantage to the operation of the dial switch. No reduction is required of the circumferential length of the upper and lower faces of the blades. For to diminish that face length between tapered end portions would affect the operation of the switch in that all four shoes of the rotary assembly must firmly and evenly press on those faces of a blade in alternate switch positions, and a minimum tolerance of length of the faces is desired. Further, the effectiveness of the gradual incline of the end portions of the blades is retained although the clearance between adjacent blades is increased.

It is undesirable to merely cut off the leading edge of the tapered end portion of the blade as shown in Fig. 7 because such a prior art arrangement results in a relatively blunt abutment of the blade 66 with the shoes 67, 68 with a relatively steep angle of incline for separating the shoes as they move onto the blade. This would necessitate increasing the force required for moving the shoes from one position to the next.

In the illustrated embodiments this increase in clearance between adjacent blades while maintaining the full effectiveness of the inclined end portions is made possible by reshaping a part of those tapered end portions and by making the springs in the rotary assembly exert a force on the shoes at a certain radial distance from the center of the dial switch. That is, the forces of the springs are exerted on the shoes at particular locations with respect to the tapered end portions of the stationary blades. The shape and arrangement of the contact elements to effect this improvement in the dial switch is illustrated best in Figs. 3 to 5. This extreme edge 41 of the outermost part of the end portion of each blade preferably extends radially of the center of the dial switch, while the extreme edge 42 of the innermost part of each end portion is cut back from the outermost edge on a diagonal line as seen in the plan view of Fig. 3. The adjacent cut back extreme edges of contiguous blades may thus be parallel to each other (Fig. 2) whereas otherwise

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they converge toward each other along radial lines. The incline or taper of the end portions is constant along the entire radial length of both the outermost and innermost parts. As a result the extreme edge of the innermost part is a generally triangularly shaped, blunt surface that effects a reduction of the electrical stress.

As can be seen from the plan view of Fig. 3 the cut back edge 42 of the innermost part intersects with the outermost part at a point 43 that may be more distant radially from the center of the dial switch than the middle or center of the shoes. Therefore, in order that the pair of shoes open properly so that the oppositely disposed surfaces thereof move substantially parallel to each other as the pair of shoes move onto a stationary blade, the rivets connecting the shoes to the conductive shunts are disposed radially from the center of the dial switch a distance equal to or beyond the point of intersection of the edges of the outermost and innermost parts of the blades. Thus, the force of the springs is exerted on the shoes radially beyond the cut back thereby providing means in the switch for keeping the shoes parallel to each other as they move onto the stationary blade. This prevents the shoes from pivoting about the heel 44 thereof as those shoes are moved onto the blade as would otherwise occur because of the shoes riding up the cut back blunt edge of the innermost part as shown in Figs. 8 and 9 for a less desirable embodiment in which the springs 51, 52 exert a force through rivets 53, 54 on the innermost part 55.

The modification illustrated in Fig. 6 differs from the embodiment shown in Fig. 3 only in that the cut back edge 61 of the innermost part of the blade does not extend radially as far away from the center of the dial switch as for the structure represented in Fig. 3. In fact, the intersection of the extreme edges of the innermost and outermost parts of the blade occurs at a point 62 approximately at the midpoint of the shoes. For this relatively short cut back, the position of the rivets 63 may be at the midpoint of the shoes, and the forces exerted by the springs 64 press approximately at that point of intersection so that the line contact between the shoes and incline of the blade will be maintained immediately the shoes engage the tip of the end portion of the blade.

The control of the action of the shoes by the force of the spring is very important. First, since it prevents tipping of the shoe about the heel thereof it reduces the flexing of the conductive shunt, thereby lengthening the life of those shunts which are made preferably from thin sheets of copper strip. In addition, it assures that where the faces of the blade are flat there will be line contact between the shoes and the blades at all times and current between the shoes and blades will be conducted between those members along that line of contact instead of at a single point of contact which would occur if the shoes pivoted about their heel as they rode up the blunt edge of the cut back part.

The operation of a dial switch embodying the teaching of this invention remains substantially the same as in switches of the prior art but the invention makes it possible to materially decrease the size of the switch or, as mentioned above, to increase the clearance between adjacent fixed contact blades. The angle of incline which the shoes must rise in going on to the stationary blades is relatively small, and may be as small

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as desired so that a minimum of force is required to move the rotary contact assembly up the angle of incline and across the blade.

Although but few embodiments of the present invention have been illustrated and described it will be apparent to one skilled in the art that various changes and modifications may be made therein without departing from the spirit of the invention or from the scope of the appended claims.

It is claimed and desired to secure by Letters Patent:

1. A dial switch comprising an insulating panel, a plurality of stationary contact blades fixed to said panel and spaced radially about a center point and circumferentially spaced from each other, and a movable contact assembly which is rotatable about said center point, said assembly including two pairs of contact shoes radially spaced from said center point so as to engage with said blades, said pairs of shoes being circumferentially spaced a distance greater than the circumferential distance between adjacent portions of said blades and less than the circumferential length of any of said blades whereby said two pairs of shoes may be made selectively to cooperate with the same blade or with adjacent blades, said shoes disposed on opposite sides of the median plane of said blades whereby said shoes rub on opposite faces of said blades, said assembly including means for biasing said shoes toward each other whereby said shoes are firmly pressed on the opposite faces of said blades, the opposed surfaces of said shoes being segmental cylindroidal portions curved in cross section normal to a radial line from said center point, the outermost part of each of the circumferentially spaced end portions of each of said blades being tapered to substantially the median plane of the blades and the innermost parts of each of said end portions terminating on a line which makes an obtuse included angle with the extreme edge of the corresponding outermost part, the extreme edges of said innermost parts of adjacent said blades being substantially parallel to each other, and said biasing means exerting a force on said shoes at a distance greater than the radial distance of the point of intersection of said extreme edges of said corresponding innermost and outermost parts.

2. A dial switch comprising an insulating panel, a plurality of stationary contact blades fixed to said panel and equally spaced radially about a center point and circumferentially spaced from each other, and a movable contact assembly which is rotatable about said center point, said assembly including two pairs of contact shoes radially spaced from said center point so as to engage with said blade, said pairs of shoes being circumferentially spaced a distance greater than the circumferential distance between adjacent portions of said blades and less than the circumferential length of any of said blades whereby said two pairs of shoes may be made selectively to operate with the same blade or cooperate with adjacent blades, said shoes disposed on opposite sides of the median plane of said blades whereby said shoes rub on opposite faces of said blades, said assembly including means for biasing said shoes toward each other whereby said shoes are firmly pressed on the opposite faces of said blades, the opposed surfaces of said shoes being segmental cylindroidal portions curved in cross section normal to a radial line from said center point, the outermost part of each of the circum-

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ferentially spaced end portions of each of said blades being tapered to substantially the median plane of the blade and the innermost part of each of said end portions terminating on a line which makes an obtuse included angle with the extreme edge of the corresponding outermost part, and said biasing means exerting a force on said shoes at a distance at least as great as the radial distance of the point of intersection of said extreme edges of said corresponding innermost and outermost parts.

3. A dial switch comprising an insulating panel, a plurality of stationary contact blades fixed to said panel and spaced radially about a center point and circumferentially spaced from each other, and a movable contact assembly which is rotatable about said center point, said assembly including two pairs of contact shoes radially spaced from said center point so as to engage with said blades, said pairs of shoes being circumferentially spaced a distance greater than the circumferential distance between adjacent portions of said blades and less than the circumferential length of any of said blades whereby said two pairs of shoes may be made selectively to cooperate with the same blade or with adjacent blades, said shoes disposed on opposite sides of the median plane of said blades whereby said shoes rub on opposite faces of said blades, said assembly including means for biasing said shoes toward each other whereby said shoes are firmly pressed on the opposite faces of said blades, the opposed surfaces of said shoes being segmental cylindroidal portions curved in cross section normal to a radial line from said center point, each of the circumferentially spaced edge portions of each of said blades being tapered and providing a broken line extreme edge for each of said portions in which the outer part of said broken line is in the median plane of said blades and extends substantially radially of said center and the inner part of said broken line extends diagonally across the taper of said end portion, said shoes being of radial length sufficient that more than half of the radial length of each of said shoes engages said blades radially beyond the inner end of said outer part, and said means contacting said shoes radially from said center point at least as distant as the inner end of said outer part.

4. A dial switch comprising an insulating panel, a plurality of stationary contact blades fixed to said panel and spaced radially about a center point and circumferentially spaced from each other, and a movable contact assembly which is rotatable about said center point, said assembly including two pairs of contact shoes radially spaced from said center point so as to engage with said blades, said pairs of shoes being circumferentially spaced a distance greater than the circumferential distance between adjacent portions of said blades and less than the circumferential length of any of said blades whereby said two pairs of shoes may be made selectively to cooperate with the same blade or with adjacent blades, said shoes disposed on opposite sides of the median plane of said blades whereby said shoes rub on opposite faces of said blades, said assembly including means for biasing said shoes of each pair toward each other whereby said shoes are firmly pressed on the opposite faces of said blades, the opposed surfaces of said shoes being segmental cylindroidal portions curved in cross section normal to a radial line from said center point, each of the circumferentially spaced edge

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portions of each of said blades being tapered and providing a broken line extreme edge for each of said portions in which the outer part of said broken line is in the median plane of said blades and the inner part of said broken line extends diagonally across the taper of said end portion, and said means contacting said shoes radially from said center point approximately as distant as the inner end of said outer part.

5. A dial switch having an insulating panel, a plurality of stationary contact blades fixed to said panel and equally spaced radially about a center point and circumferentially spaced from each other, and a movable contact assembly which is rotatable about said center point including a pair of oppositely disposed contact shoes radially spaced from said center point to selectively engage with said blades, said shoes disposed on opposite sides of the median plane of said blades, said assembly including means for biasing said shoes toward each other whereby said shoes cooperate with the opposite faces of said blades, the outermost part of each of the circumferentially spaced end portions of each of said blades being tapered to substantially the median plane of the blade and the innermost part of each of said end portions terminating on a line which makes an obtuse included angle with the extreme edge of the corresponding outermost part, the extreme edges of said innermost parts of adjacent said blades being parallel to each other, said biasing means exerting a force on said shoes at a distance greater than the radial distance of the point of intersection of said extreme edges of said corresponding innermost and outermost parts.

6. A dial switch having an insulating panel, a plurality of stationary contact blades fixed to said panel and equally spaced radially about a center point and circumferentially spaced from each other, and a movable contact assembly which is rotatable about said center point including a pair of oppositely disposed contact shoes radially spaced from said center point to selectively engage with said blades, said shoes disposed on opposite sides of the median plane of said blades, said assembly including means for bias-

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ing said shoes toward each other whereby said shoes cooperate with the opposite faces of said blades, each of the circumferentially spaced edge portions of each of said blades being tapered and providing a broken line extreme edge for each of said portions in which the outer part of said broken line is in the median plane of said blades and extends substantially radially of said center and the inner part of said broken line extends diagonally across the taper of said end portion, said shoes being of radial length sufficient that more than half of the radial length of each of said shoes engages said outer part of said blades radially beyond the inner end of said outer part, and said means contacting said shoes only radially from said center point at least as distant as the inner end of said outer part.

7. A dial switch having an insulating panel, a plurality of stationary contact blades fixed to said panel and equally spaced radially about a center point and circumferentially spaced from each other, and a movable contact assembly which is rotatable about said center point including a pair of oppositely disposed contact shoes radially spaced from said center point to selectively engage with said blades, said shoes disposed on opposite sides of the median plane of said blades, said assembly including means for biasing said shoes toward each other whereby said shoes cooperate with the opposite faces of said blades, each of the circumferentially spaced edge portions of each of said blades being tapered and providing a broken line extreme edge for each of said portions in which the outer part of said broken line is in the median plane of said blades and the inner part of said broken line extends diagonally across the taper of said end portion, and said means contacting said shoes radially from said center point approximately as distant as the inner end of said outer part.

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Number	Name	Date
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