A. B. HENDRICKS, JR.

SWITCH MECHANISM.

APPLICATION FILED FEB. 14, 1921.

1,412,002.

Patented Apr. 4, 1922.

2 SHEETS—SHEET 1.

Fig. 1.

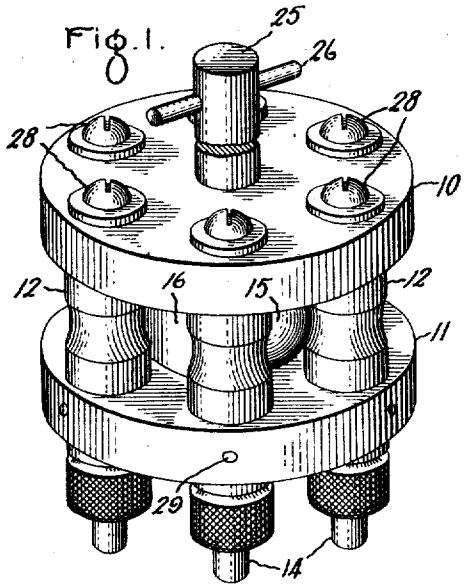


Fig. 2.

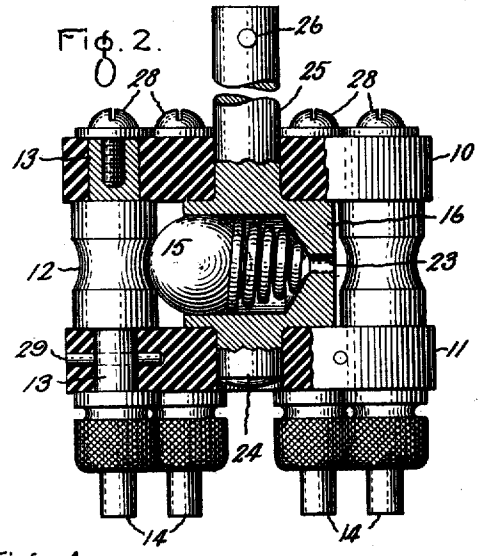


Fig. 3.

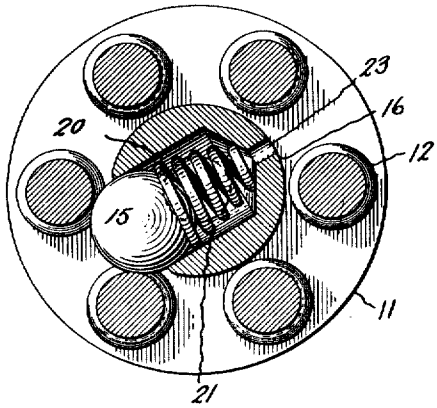
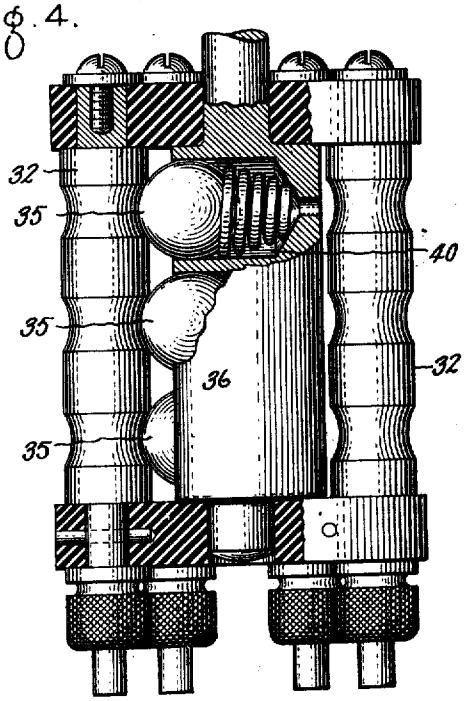


Fig. 4.



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His Attorney.

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2 SHEETS—SHEET 2.

Fig. 5.

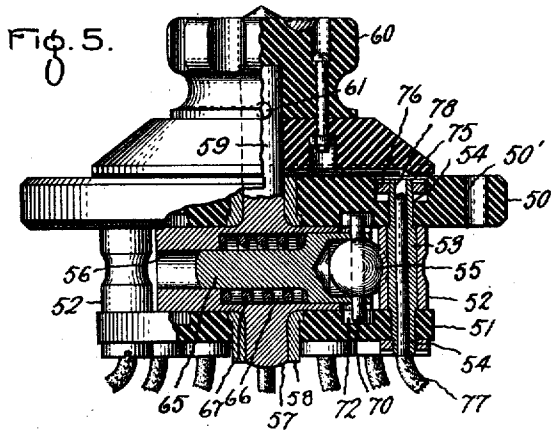


Fig. 7.

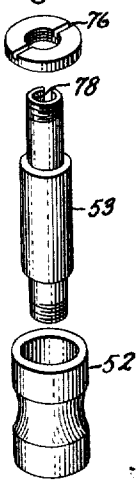


Fig. 6.

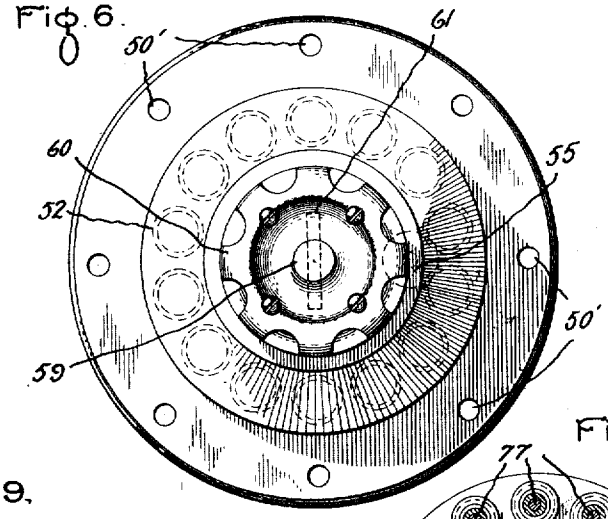


Fig. 8.

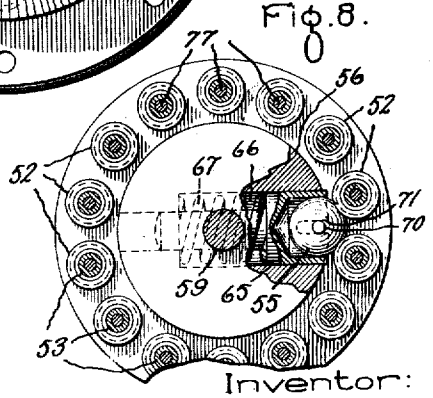
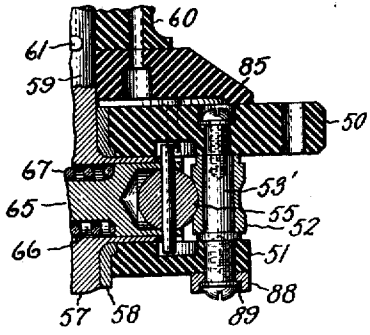


Fig. 9.



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by Albert G. Davis
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UNITED STATES PATENT OFFICE.

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SWITCH MECHANISM.

1,412,002. Specification of Letters Patent. Patented Apr. 4, 1922.

Application filed February 14, 1921. Serial No. 444,777.

To all whom it may concern:

Be it known that I, ALLAN B. HENDRICKS, Jr., a citizen of the United States, residing at Pittsfield, county of Berkshire, State of Massachusetts, have invented certain new and useful Improvements in Switch Mechanism, of which the following is a specification.

My invention relates to switch mechanisms for electrical apparatus. More particularly my invention relates to switch mechanisms which are adapted to adjust voltage ratios in stationary induction electrical apparatus having windings provided with taps for that purpose.

The service required of tap changing or switching mechanisms adapted to adjust voltage ratios is very different from that required of ordinary switch mechanisms. In ordinary cases the switch mechanism must be arranged to rupture safely the maximum current which it is designed to carry.

In ratio adjusting devices, however, the problem is reversed. The mechanism is only required to rupture a relatively small current (the magnetizing current in transformers or auto-transformers) in comparison with that carried during normal operation since it is generally not permissible to adjust voltage ratios under load. The problems of quick makes and breaks and of quenching arcs are accordingly relatively unimportant. On the other hand, the mechanism is required to carry the full load current under operating conditions. The problem of securing adequate contact between the current carrying parts and providing adequate ventilation accordingly becomes signally important in this type of service since it is imperative to provide such mechanism without undue weight or bulk.

In accomplishing my invention I provide an improved arrangement of parts which is simple and rugged with all current carrying parts exposed and accessible to ventilation. The contact-making parts are designed always to make line contact so as to have maximum current carrying capacity. To this end I employ a spherical bridging member in preference to any other form and arrange it to engage correspondingly grooved contact posts; the bridging member in this form being capable of considerable self-adjustment so as to make a line in spite of slight variations in the alignment of the contact posts.

For a more complete understanding of the nature and objects of my invention, reference should be had to the following detailed description taken in connection with the accompanying drawings in which:

Fig. 1 is a perspective view of a switch mechanism adapted for adjusting voltage ratios which is constructed in accordance with my invention; Fig. 2 is a vertical section of the mechanism shown in Fig. 1, while Fig. 3 is a horizontal section of the same mechanism; Fig. 4 is a view similar to Fig. 2, but of a modified form of mechanism which is adapted to carry larger currents than the first form shown; Figs. 5, 6, 7 and 8 are sectional, plan and detail views of another modification of my switch mechanism which is particularly adapted for use on the exterior of casings for electrical apparatus, while Fig. 9 shows a further modification of the form of switch mechanism shown in Fig. 5.

Referring now to the drawings, and to Fig. 1 in particular, 10 and 11 denote respectively upper and lower discs of insulating material which are provided with contact posts 12 evenly spaced about their circumferences. These contact posts preferably have reduced portions 13 extending through the discs 10 and 11, the lower portions being provided with connecting members 14 to which lead the taps from the electrical winding whose voltage ratios are to be changed. Each contact post 12 is also grooved circumferentially with a groove whose radius of curvature is the same as the radius of the spherical bridging member 15 which is mounted in and is moved by the rotatable member 16.

The bridging member 15 is a ball of good conducting material and reciprocates in the cylindrical recess 20 which is formed transverse to the axis of rotation of the rotatable member 16. Back of the ball 15 and reacting against the bottom of the recess 20 is the spring 21 which presses the ball out of the recess so that it protrudes slightly between a pair of contact posts 12 as shown in Fig. 3, at the same time forcing the ball into intimate engagement with each of the circumferential grooves on the contact posts 12, thereby making complete contact throughout the arc of the grooves. The bottom of the

recess 20 is preferably provided with a vent opening 23 as shown.

The rotatable member 16 is provided with shanks 24 and 25 journaled in the discs 10 and 11 centrally of the contact posts 12, one such shank 25 being extended to serve as an operating shaft, a pin 26 being preferably provided for securing an operating handle to the shaft.

The construction just described is compact and light and lends itself readily to the production of a very rigid structure, the disc 10 being prevented from displacement by the screws and washers at 28 which engage with the upper reduced portions of each of the contact posts. The disc 11, however, is shown as secured by means of pins 29 which enter the disc radially and engage with openings in the lower reduced portions of posts 12.

All current carrying parts are thus located about the exterior of the device and accordingly are well ventilated, the structure being adapted to be fitted down beside the winding from which the voltage ratio adjusting taps lead.

The advantage of the curvilinear engagement of the current carrying members (the ball and contact posts) in this construction is obvious when it is considered that if we had cylindrical contact posts to be engaged by a bridging member with a cylindrical surface, then any slight disalignment of the members at once prevents line contacts from being made. Point contacts result with consequent overheating of the parts when carrying full load current. In my construction, however, the arcs of the circumferential grooves on the contact posts 12 are segments of great circles of the spherical member 15. Hence whatever the alignment of posts 12 they will engage throughout the length of their arcuate grooves with the surface of member 15; a line contact thus always resulting.

In Fig. 4 I have shown an arrangement adapted for higher current carrying capacity than the form first described. Here the rotatable member 36 carries a plurality of spherical bridging members 35, three being shown; which members reciprocate in individual recesses 40, similar to those at 20, formed in member 36.

In this form the contact posts 32 carried by the insulating discs have circumferentially formed grooves which have radii of curvature corresponding respectively with those for each of the balls or spherical members 35. The posts 32 are thus shown each with three grooves, the cross-sectional area of the posts being made sufficient to impart the desired mechanical stiffness to the construction.

In Fig. 5 a construction is illustrated particularly adapted for mounting on the exterior of the casing containing the winding having the voltage changing taps.

Insulating discs 50 and 51 are here again used to support the contact posts 52 which are evenly spaced about their circumferences. The upper insulating disc 50 here, however, is made larger than the lower one since it is desired to provide it with a margin adapted to support the device. Accordingly, this margin has openings at 50' which are adapted to receive bolts or other suitable means for securing the device to the casing wall.

The contact posts 52 are circumferentially grooved as before, but are hollow and are slipped over and adapted to revolve about the stationary cylindrical cores 53 which have their reduced ends 54 secured in the discs 50 and 51.

A spherical bridging member or ball 55 is carried by the rotatable member 56 which is journaled centrally of the contact posts 52. The lower journal of the rotatable member is shown at 57 turning in a bushing 58 secured in the disc 51. The upper journal 59 is likewise bushed and extends sufficiently to have a manipulating handle 60 secured thereto by means of pin 61.

In the construction illustrated it is desirable to have the ball 55 carried not directly by the rotatable member but by a plunger 65 mounted and reciprocating in the recess 66 in the rotatable member, which plunger is pressed outwardly by the spring 67 in the recess.

In order that the ball 55 may turn with as little friction as possible I mount it on the axial pin 70 which traverses an axial bore in the ball 55 and has its ends engaged with upper and lower slots 71 cut in the plunger 65. The pin 70 is somewhat extended at both ends to project beyond the slots 71 and upper and lower annular grooves 72 are formed in the inner faces of discs 50 and 51 in which the ends of the pin track. These grooves need not be complete annuli where it is desired to have them discharge a stop function.

For a similar reason it is desired that the contact posts 52 shall be rotatably mounted on their stationary cores 53, i. e. in order to reduce friction in the moving parts when the ball 55 is moved to change tap connections. By this arrangement sliding friction in the structure is reduced to a minimum and rolling friction is substituted.

The construction shown in Fig. 5 is adapted to have the taps from the windings secured to the contact posts 52 in a very advantageous manner. To this end the cores 53 are made tubular, their upper ends being disposed in countersunk recesses 75 formed in the upper face of the disc 50. These ends have threaded kerfed washers 76, which may be screwed down by a suit-

able tool, when engaging the kerf, so as to engage with and hold securely the tip end of the tap lead; the latter as shown at 77 has its terminal portion stripped and inserted up through the bore of the core 53, its tip finally being bent over and brought out though the slot 78 formed in the side of the upper end of core 53, which is clearly shown in Fig. 7.

This construction permits the switch mechanism to be secured in place on the wall of the apparatus casing and the tap connections made afterwards. When this procedure is followed the handle 60 is removed, the pin 61 having first been displaced. The stripped ends of the tap leads, which preferably were partially inserted before the switch mechanism was finally secured, are then drawn up into place, the tips bent out through the slots 78 and the washers 76 screwed into place. The handle 60 may now be replaced and the switch mechanism placed in operation.

The modification shown in Fig. 9 is similar to that shown in Fig. 5 but the cores 53' on which the cylindrical contact posts 52 turn, are not hollow. Instead they are solid and have an ordinary screw and nut arrangement for holding them in the countersunk openings 85 in the top face of the disc 50, a similar construction obtaining at the lower end; at this latter end, however, a countersunk washer 88 is used in addition to the ordinary washer 89 between which the tips of the tap leads are secured.

Having now described several embodiments of my invention which are at present the best means known to me for carrying the same into effect, I would have it understood that these are merely illustrative and that I do not mean to be limited thereby to the precise details shown nor restricted in the choice of recognized equivalents except as defined in my claims hereunto annexed.

What I claim as new and desire to secure by Letters Patent of the United States, is:—

1. A switch mechanism adapted for tap changing comprising in combination a pair of insulating discs, contact posts having circumferential grooves disposed about the peripheries of said discs, a rotatable member disposed between said discs centrally of said contact posts, and a spherical bridging member in said rotatable member and arranged to engage with said grooves.

2. A switch mechanism adapted for tap changing comprising in combination a pair of insulating discs, contact posts having circumferential grooves disposed about the peripheries of said discs, a rotatable member disposed between said discs centrally of said contact posts, said rotatable member having a recess, and a spherical bridging member mounted in said recess and arranged to engage with said grooves.

3. A switch mechanism adapted for tap changing comprising in combination a pair of insulating discs, contact posts having circumferential grooves disposed about the peripheries of said discs, a rotatable member disposed between said discs centrally of said contact posts, said rotatable member having a recess, and a spherical bridging member resiliently mounted in said recess having the same radius of curvature as said grooves and arranged to engage successively each pair of grooves as the rotatable member is turned.

4. A switch mechanism adapted for tap changing comprising in combination a pair of insulating discs, contact posts having circumferential grooves disposed about the peripheries of said discs, a rotatable member disposed between said discs centrally of said contact posts and having a recess, a spring in the recess, and a spherical bridging member mounted in said recess reacting against said spring and adapted to protrude partially between a pair of contact posts and engage with their circumferential grooves.

5. A switch mechanism adapted for tap changing comprising in combination a pair of insulating discs, contact posts having circumferential grooves disposed about the peripheries of said discs, a rotatable member disposed between said discs centrally of said contact posts and having a recess, a spring in the recess, a conducting ball in said recess having the same radius of curvature as said grooves reacting against said spring and adapted to protrude between and bridge a pair of contact posts in the region of their circumferential grooves.

6. A switch mechanism adapted for tap changing comprising in combination a pair of insulating discs, contact posts having circumferential grooves disposed about the peripheries of said discs, a rotatable member disposed between said discs centrally of said contact posts and having a recess, a spring in the recess, a plunger in the recess pressed outwardly by said spring, and a spherical bridging member mounted in said plunger and adapted to engage with the circumferential grooves of a pair of contact posts.

7. A switch mechanism adapted for tap changing comprising in combination a pair of insulating discs, contact posts having circumferential grooves disposed about the peripheries of said discs, a rotatable member disposed between said discs centrally of said contact posts and having a recess, and a spherical bridging member axially supported in said recess and arranged to engage with the grooves in said posts, said posts arranged only for rolling frictional engagement by said bridging member.

8. A switch mechanism adapted for tap changing comprising in combination a pair of insulating discs, contact posts having circumferential grooves disposed about the pe-

ripheries of said discs, a rotatable member disposed between said discs centrally of said contact posts and having a recess, a plunger resiliently supported in said recess, and a spherical bridging member having the same radius of curvature as said grooves axially supported by said plunger, said posts being adapted to rotate and to have their grooves engaged by said bridging member.

9. A switch mechanism adapted for tap changing comprising in combination a pair of insulating discs, contact posts having circumferential grooves disposed about the peripheries of said discs, a rotatable member disposed between said discs centrally of said contact posts and having a recess, a plunger resiliently supported in said recess, a spherical bridging member having the same radius of curvature as said grooves, and means in said plunger axially supporting said bridging member, said contact posts having interior cores mounted stationary between said discs and exterior cylindrical portions turning on said cores and adapted for rolling frictional engagement by said bridging member in the region of their grooves.

10. A switch mechanism adapted for tap changing comprising in combination a pair of insulating discs, contact posts having circumferential grooves disposed about the peripheries of said discs, said posts having axial hollow portions each adapted to receive the end of a tap lead, a rotatable member disposed centrally of said contact posts, and a spherical bridging member carried by said rotatable member and arranged to engage with said contact posts in the region of their grooves.

11. A switch mechanism adapted for tap changing comprising in combination a pair of insulating discs, contact posts having circumferential grooves disposed about the peripheries of said discs, each of said posts having an axial hollow portion adapted to receive the end of a tap lead and having a side slot at one end, means on said end of each post arranged in conjunction with said slot to clamp the lead in place, a rotatable member disposed centrally of said contact posts, and a spherical bridging member carried by said rotatable member and arranged to engage with said posts in the region of their grooves.

12. A switch mechanism adapted for tap changing comprising in combination a pair of insulating discs, contact posts having circumferential grooves disposed about the peripheries of said discs, said posts having hollow core portions mounted stationary between said discs, each post being adapted to receive the stripped end of a tap lead and having outer cylindrical portions turning freely on said core portions, a rotatable member disposed centrally of said contact posts, and a spherical bridging member having the same radius of curvature as said grooves and suspended axially in said rotatable member, said bridging member being adapted to turn freely about such axis of suspension and engage with said contact posts in the region of their circumferential grooves, whereby there is a line contact in all operative positions between said bridging member and a pair of contact posts, there being only rolling friction between the parts when said bridging member is moved from one operative position to another.

In witness whereof, I have hereunto set my hand this 9th day of Feb., 1921.

ALLAN B. HENDRICKS, JR.