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[56] References Cited
 UNITED STATES PATENTS
2,127,608 8/1938 Manley.....200/166(0)(X)
3,233,049 2/1966 Bleibtreu..... 200/11(TC)
 FOREIGN PATENTS
367,876 4/1963 Switzerland..... 200/11(TC)

Primary Examiner—H. O. Jones
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[54] HIGH VOLTAGE SWITCHING DEVICE
 12 Claims, 4 Drawing Figs.
[52] U.S. Cl..... 200/166,
 200/11, 200/170
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 H01n 1/50

ABSTRACT: A high voltage switching device of the type including fixed contact means and a movable contact bridge for conductively interconnecting said fixed contact means is provided with means for effectively controlling the electric field established between separated contacts.

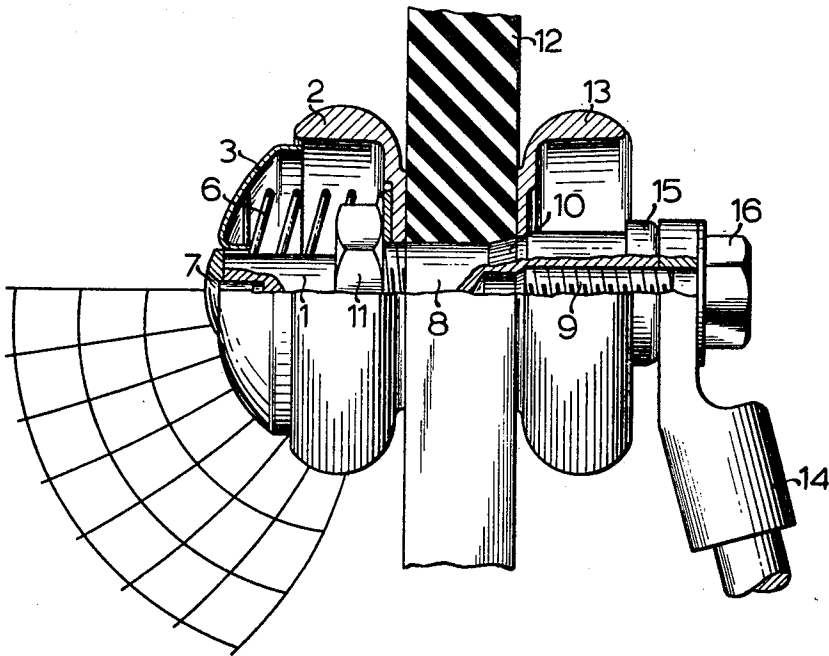


FIG. 1

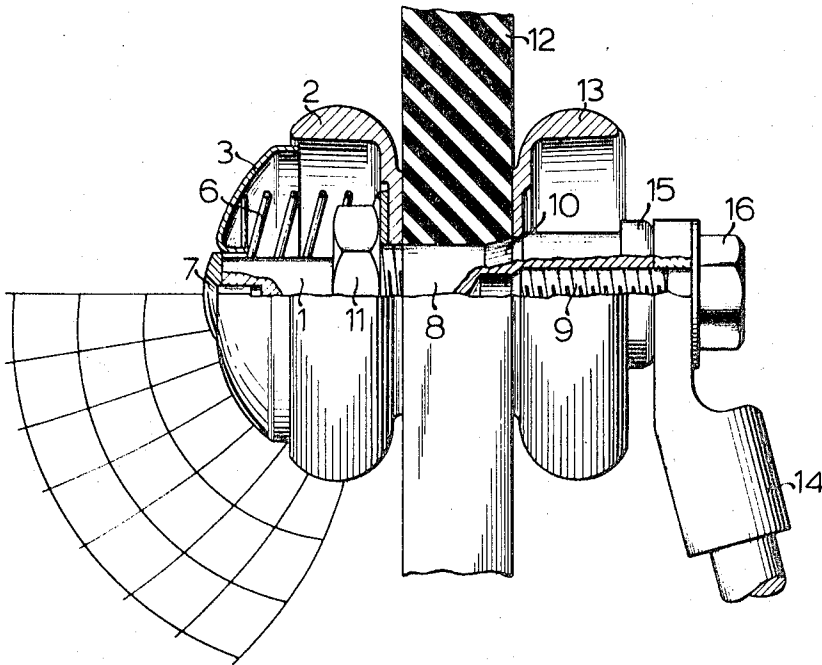


FIG. 2

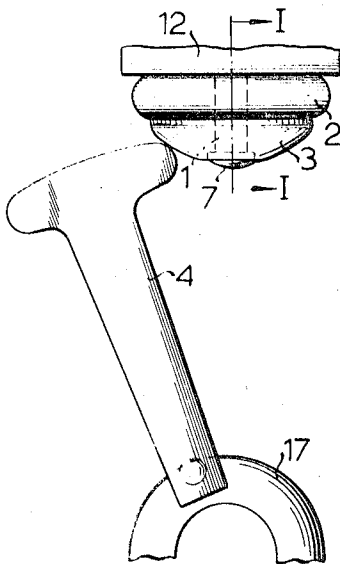


FIG. 3

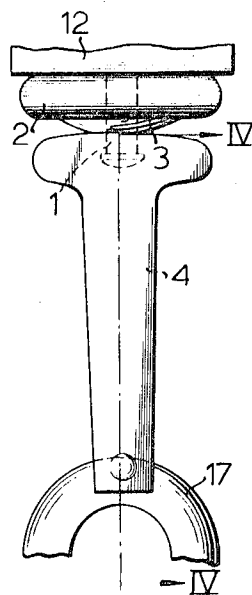
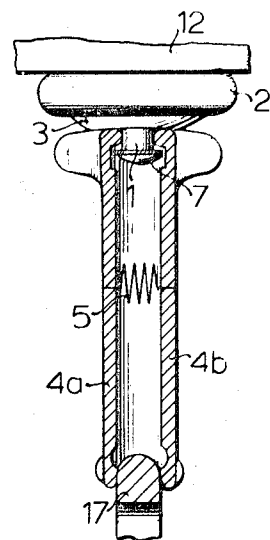


FIG. 4



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HIGH VOLTAGE SWITCHING DEVICE

BACKGROUND OF INVENTION

This invention relates to the control of the electric field inside the gap formed between the separated contacts of a high voltage switching device. It is particularly applicable to selector switches for tap-changing regulating transformers as disclosed, for instance, in U.S. Pat. 3,233,049 to A. Bleibtreu, issued Feb. 1, 1966 for INTEGRAL SELECTOR SWITCH AND TRANSFER SWITCH UNIT FOR TAPPED REGULATING TRANSFORMERS. The invention is, however, not limited to the aforementioned type of selector switches, but applicable to many other types of switches, particularly any kind of rotary high voltage selector switches. Rotary selector switches often include a fixed radially inner circular or annular contact, a contact bridge pivotable about the center of said circular or annular contact and having a radially inner contact surface in permanent engagement with said circular or annular contact, and a plurality of fixed radially outer contacts arranged in a circular concentric pattern around said circular or annular contact and selectively engageable by a radially outer contact surface of said contact bridge. In such a rotary selector switch each of said plurality of fixed radially outer contacts not engaged by the radially outer contact surface of the contact bridge is normally within a high voltage electric field. The dielectric strength of the gap formed between the radially inner circular or annular contact and said plurality of radially outer contacts depends upon the configuration of the latter, and upon the spacing between the former and the latter. In the interest of compactness this spacing ought to be minimized. Compactness of a tap-changing selector switch is a requirement of prime importance wherever it is intended to arrange such a switch in the tank provided for housing a transformer whose winding, or windings, are tapped. Given a potential difference between the fixed radially inner circular or annular contact, and the aforementioned plurality of fixed radially outer contacts, the spacing between these fixed contacts can be minimized if concentrations of the electric field can be avoided, and the field gradient kept as even or as uniform as possible. This condition can be met if the shape of each of the aforementioned plurality of fixed contacts approximates a sphere. This invention relates to a fixed contact structure approximating a sphere.

SUMMARY OF INVENTION

A high voltage switching device according to this invention includes fixed contacts and a movable contact bridge for conductively interconnecting pairs of said fixed contacts. Some of said fixed contacts include a contact rod, a substantially cup-shaped shielding member arranged in coaxial relation to said contact rod and enveloping a portion of the length thereof, said shielding member defining a circular opening through which said contact rod projects from the inside of said shielding member to the outside thereof, a closing member for said shielding member having substantially the shape of a spherical cap arranged in coaxial relation to said shielding member and having an outer diameter slightly less than the diameter of said circular opening of said shielding member, and spring means interposed between said shielding member and said closing member biasing said closing member in a direction longitudinally of said rod contact away from said shielding member.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is in part a side elevation and in part a vertical section along I-I of FIG. 2 and shows a fixed contact according to this invention and means for securing a cable to it;

FIG. 2 is a top plan view of an assembly embodying this invention and including a pair of fixed contacts and of a cooperating contact bridge, the contact bridge being in engagement with one of the pair of fixed contacts and about to engage the other of the pair of fixed contacts;

FIG. 3 shows the same structure as FIG. 2 in the same fashion as FIG. 2, the contact bridge being shown in FIG. 3 in its position of full or complete contact engagement; and

FIG. 4 is in part a side elevation of the structure of FIG. 3 and in part a section along IV-IV of FIG. 3.

DESCRIPTION OF PREFERRED EMBODIMENT

Referring to the drawings, numeral 1 has been applied to indicate a fixed rod contact, numeral 2 has been applied to indicate a fixed circular or annular contact, and numeral 4 has been applied to indicate a contact bridge for conductively interconnecting fixed contacts 1 and 17. Contact bridge 4 is pivotable about the center of circular or annular contact 17. The radially inner end of contact bridge 4 has a contact surface or several such surfaces that remain in sliding engagement with circular or annular contact 17 as contact bridge 4 is being pivoted by means not shown about the center of fixed contact 17. Contact bridge 4 is substantially T-shaped as seen in top-plan view (FIGS. 2 and 3), and its radially outer end travels along a circular trajectory when it is being pivoted about the center of fixed contact 17. A plurality of fixed contact rods 1 and associated parts may be arranged along the circular trajectory of the radially outer end of bridge 4 as is well known in the art of rotary selector switches and shown in U.S. Pat. No. 3,233,049 referred to above.

As shown in FIG. 1 a substantially cup-shaped shielding member 2 is arranged in coaxial relation to contact rod 1 and envelops a portion of the length thereof. Shielding member 2 defines a circular opening situated to its left, as seen in FIG. 1, and forms a recess, and rod contact 1 projects from the outside of member 2 through the aforementioned opening into the aforementioned recess. Reference numeral 3 has been applied to indicate a closing member for shielding member 2 and its opening, respectively. Closing member 3 is substantially in the shape of a spherical cap arranged in coaxial relation to shielding member 2. Shielding member 2 and its closing member 3 have outer surfaces which are substantially spherical and have the same radii. The outer diameter of closing member 3 is slightly less than the diameter of the circular opening of shielding member 2. This makes it possible to move closing member 3 into shielding member 2 by relative movement of both members in the direction of the common axis thereof. A helical spring 6 is interposed between shielding member 2 and closing member 3 biasing the closing member in a direction longitudinally of rod contact 1 away from shielding member 2. Since the radii of the outer surfaces of members 2, 3 are equal, their outer surfaces define jointly a substantially hemispherical envelope. The axially outer end of member 3 has a reentrant portion forming a bearing surface in engagement with, and supported by, contact rod 1. The end surface of contact rod 1, i.e. its surface which forms its left end, as seen in FIG. 1, is spherical and has substantially the same radius as parts 2 and 3, and defines an abutment cooperating with closing member 3 and limiting the movement thereof under the action of spring means 6. Contact rod 1 has a rear extension including a screw-threaded stud terminal 9 supporting a nut 16 for securing a cable shoe 14 to it. The aforementioned rear extension of contact rod 1 supports an additional substantially cup-shaped shielding member 13. The latter has substantially the same geometrical configuration as shielding member 2. Reference character 12 has been applied to indicate a vertical bar support of electric insulating material supporting contact rod 1 and all the parts associated with contact rod 1 such as, for instance, components 2, 3 and 13. Mounted on contact rod 1 is a hexagonal nut 11 abutting against or engaging the bottom of the recess defined by shielding member 2, or a washerlike insert in the bottom of shielding member 2. Screw 8 is integral with contact rod 1, and projects transversely through insulating support 12. Screw 8 has a knurled surface 10 in the shape of a frustum of a cone for clamping parts 1, 2, etc. against insulating support 12, and precluding any rotational motion of these parts relative to in-

sulating support 12. The cable shoe 14 is clamped between a collar 15 integral with stud 9 and hexagonal nut 16 mounted on the axially outer screw-threaded end of stud 9.

As shown in FIG. 4 contact bridge 4 is preferably made up of two separate complementary parts 4a, 4b biased toward each other by a spring 5. The radially inner ends of parts 4a, 4b are in permanent engagement with annular contact 17, as shown at the bottom of FIG. 4. The radially outer ends of components 4a, 4b may part from each other against the bias of spring 5, and allow contact rod 1 to enter into the gap formed by the separation thereof. As shown in FIG. 4, the radially outer ends of parts 4a, 4b form a pair of shoulders being overlapped by the spherical head 7 of rod contact 1 when the latter is clamped between the two complementary portions 4a, 4b of bridge 4.

As long as bridge 4 is out of engagement with contact rod 1 the latter is fully shielded by components 2 and 3, forming a hemisphere. Component 13 provides a shielding effect for the cable shoe 14.

During switching operations contact bridge 4 is moved, or pivoted, to successive radial positions. When the radially outer end of bridge 4 engages closing member 3, as shown in FIG. 2, a force transmitted from contact bridge 4 to closing member 3 causes the latter to move axially inwardly along contact rod 1 against the bias of spring means 6. This exposes contact rod 1. The action of contact rod 1 upon the complementary components 4a, 4b of contact bridge 4 causes parting of these components and allows rod contact 1 to enter into the gap formed by parting of components 4a, 4b. This has been shown in FIGS. 3 and 4.

When contact bridge 4 separates from one of its cooperating fixed contact rods 1 the closing member 3 is allowed to move axially outwardly under the bias of spring means 6, thus reestablishing the hemispherical configuration of the structure and its full shielding action.

It will be apparent from the above that contact rod 1 is substantially cylindrical, or has a lateral cylindrical surface and that contact rod 1 defines a longitudinal axis. The fulcrum (not shown) of contact bridge or pivotable contact means 4 is arranged at a point situated along the aforementioned longitudinal axis defined by contact rod 1. The web portion of T-shaped bridge or movable contact means 4 extends radially outwardly from the aforementioned fulcrum and its flange portion form abutments engaging closing member 3 and moving the latter against the bias of spring 6 into the recess of shielding member 2. Fig. 4 shows clearly that the radially outer contact surface of parts 4a, 4b engage opposite surface elements of the lateral surface of rod contact 1 upon movement of closing member 3 into the recess of shielding member 2.

While the invention has been particularly shown and described with reference to a preferred embodiment thereof, it will be understood by those skilled in the art that changes in form and details may be made without departing from the spirit and scope of the invention as set forth in the appended claims.

I claim:

1. A high voltage switching device including fixed contacts and a movable contact bridge for conductively interconnecting pairs of said fixed contacts wherein some of said fixed contacts include:

- a. a contact rod;
- b. a substantially cup-shaped shielding member arranged in coaxial relation to said contact rod and enveloping a portion of the length thereof, said shielding member defining a circular opening through which said contact rod projects from the inside of said shielding member to the outside thereof;
- c. a closing member for said shielding member having substantially the shape of a spherical cap arranged in coaxial relation to said shielding member and having an outer diameter slightly less than the diameter of said circular opening of said shielding member; and

d. spring means interposed between said shielding member and said closing member biasing said closing member in a direction longitudinally of said contact rod away from said shielding member.

2. A switching device including a fixed radially inner circular contact, a contact bridge pivotable about the center of said circular contact and having a radially inner contact surface in permanent engagement with said circular contact, and a plurality of fixed radially outer contacts arranged in a circular concentric pattern around said circular contact and selectively engageable by a radially outer contact surface of said contact bridge wherein each of said plurality of radially outer fixed contacts includes a contact rod, a shielding member, a closing member and spring means as specified in claim 1.

3. A switching device as specified in claim 1 wherein said shielding member and said closing member have outer surfaces defining jointly a substantially hemispherical envelope.

4. A switching device as specified in claim 1 wherein said closing member is slidably mounted on said contact rod.

5. A switching device as specified in claim 1 wherein the end surface of said contact rod remote from said shielding member is spherical and defines an abutment cooperating with said closing member and limiting the movement of said closing member under the action of said spring means.

6. A switching device as specified in claim 1 wherein said contact rod has a rear extension including a screw-threaded stud-terminal supporting a nut for securing a cable to said contact rod.

7. A switching device as specified in claim 6 wherein said rear extension of said contact rod forming a stud terminal supports and additional shielding member having substantially the same geometrical configuration as said shielding member.

8. A switching device as specified in claim 6 wherein said rear extension includes screw means for attaching said contact rod to a perforated support, said screw means including a knurled surface in the shape of a frustum of a cone.

9. A high voltage switching device including in combination:

- a. a fixed rod contact having a lateral surface and defining a longitudinal axis;
- b. a shielding member for said rod contact arranged in coaxial relation to said rod contact, said shielding member having a substantially spherical outer surface and having a recess therein;
- c. a substantially spherical closing member conforming to the shape of said recess and movable into said recess;
- d. spring means biasing said closing member in the direction of said longitudinal axis defined by said rod contact out of said recess; and
- e. pivotable contact means having a fulcrum arranged at a point situated along said longitudinal axis, said pivotable contact means having a radially outer abutment surface arranged to engage said closing member and to move said closing member against the bias of said spring means into said recess of said shielding member, and said pivotable contact means further having a radially outer contact surface engageable with said lateral surface of said rod contact upon movement of said closing member into said recess of said shielding member.

10. A high voltage switching device as specified in claim 9 wherein said pivotable contact means is substantially T-shaped including a web portion and a flange portion, said web portion extending radially outwardly from said fulcrum, and said flange portion forming said radially outer abutment surface arranged to engage said closing member and to move said closing member against the bias of said spring means into said recess of said shielding member.

11. A high voltage switching device as specified in claim 9 wherein said pivotable contact means includes two separate complementary portions spring biased toward each other, each of said portions having a radially outer contact surface engageable with opposite surface elements of said lateral surface of said rod contact upon movement of said closing member into said recess of said shielding member.

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12. A high voltage switching device as specified in claim 9 wherein said closing member has a reentrant portion forming a bearing mounted on said lateral surface of said rod contact and wherein the end surface of said rod contact remote from

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said shielding member is substantially spherical, has substantially the same radius as said shielding member and said closing member and forms an abutment limiting the movement of said closing member under the bias of said spring means.

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