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Keto et al.

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[54] **ROTARY ELECTRICAL SWITCHING CONTACT ASSEMBLY WITH HOLLOW INSULATING ARC BARRIER**

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[73] Assignee: **Westinghouse Electric Corporation**, Pittsburgh, Pa.

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[52] **U.S. Cl.**.....**200/151**, 200/155 R, 200/162

[51] **Int. Cl.**.....**H01h 9/32**, H01h 33/06, H01h 21/54

[58] **Field of Search**.....200/151, 162, 166 E, 155 R, 200/168 K

[56] **References Cited**

UNITED STATES PATENTS

1,895,330	1/1933	Kempton	200/151 X
524,717	8/1894	Harris	200/151 UX
1,785,194	12/1930	Hammerly	200/162
3,218,425	11/1965	Olenick et al.	200/168 UX
3,590,183	6/1971	Leonard	200/166 E X
954,462	4/1910	Peterson	200/151
3,251,956	5/1966	Rasor et al.	200/168 K UX

FOREIGN PATENTS OR APPLICATIONS

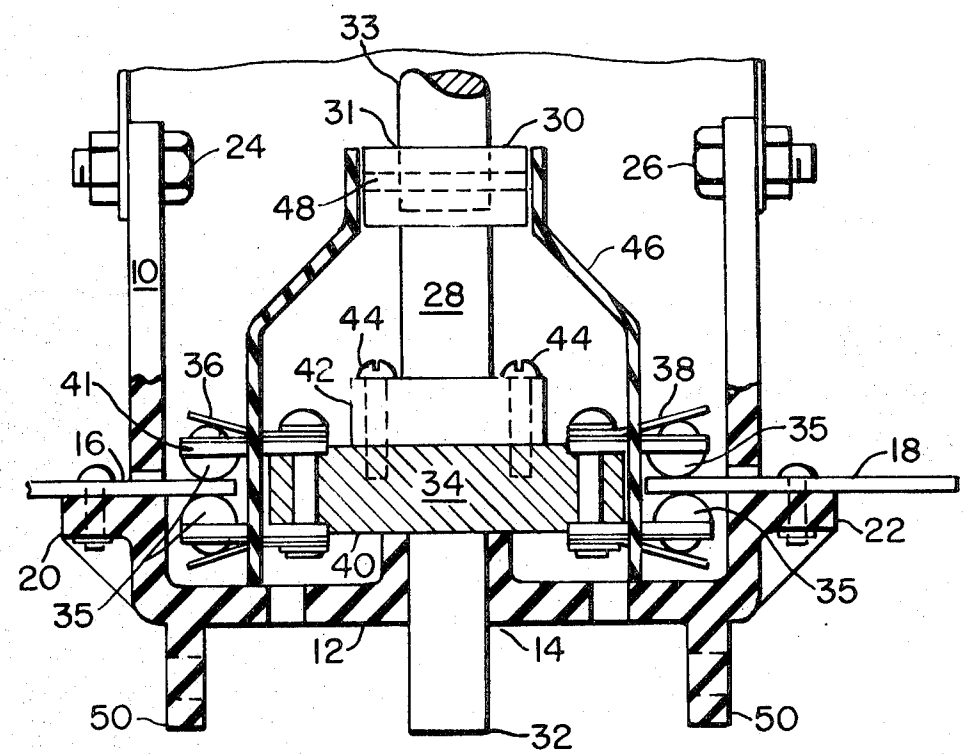
35,161	11/1934	Netherlands	200/151

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Assistant Examiner—Robert A. Vanderhye
Attorney—A. T. Stratton and F. E. Browder

[57] **ABSTRACT**

An electrical switching contact assembly having a housing with stationary contacts mounted thereon, and a rotating shaft with movable contacts attached thereto. The rotating shaft is mounted within the housing in a manner which will permit the stationary and movable contacts to engage when the switch is closed. The housing and shaft are constructed to permit stacking of the assembly for polyphase switching operations. An insulated hollow arc barrier member is disposed around the movable contact assembly.

2 Claims, 7 Drawing Figures



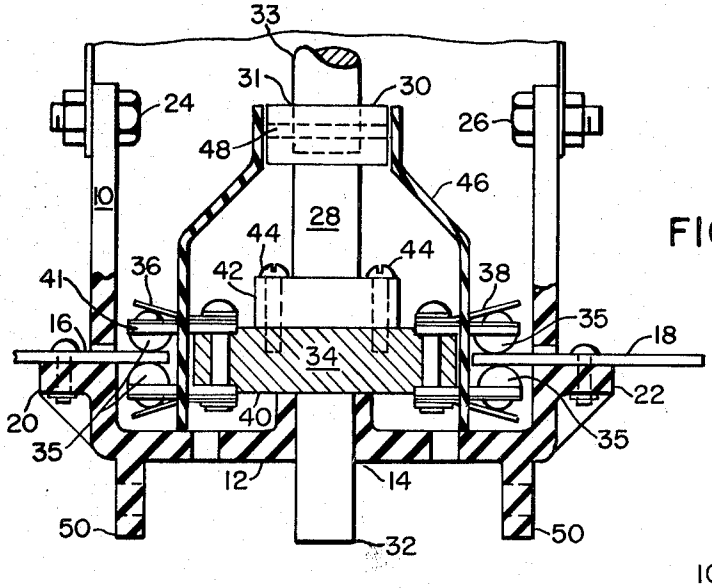


FIG. 1

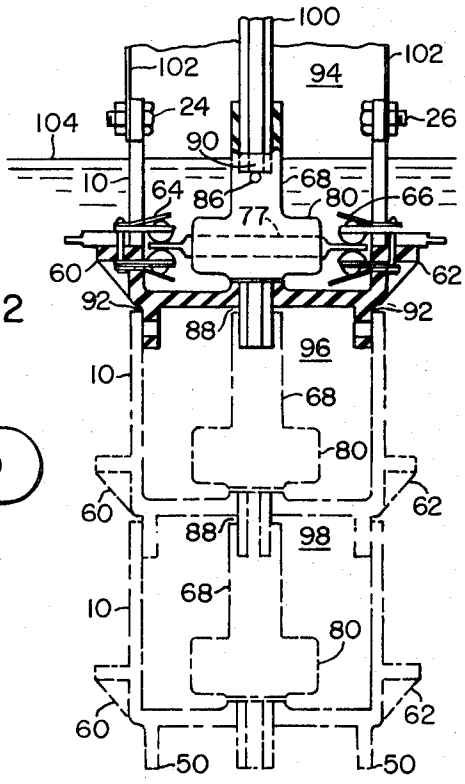


FIG. 4

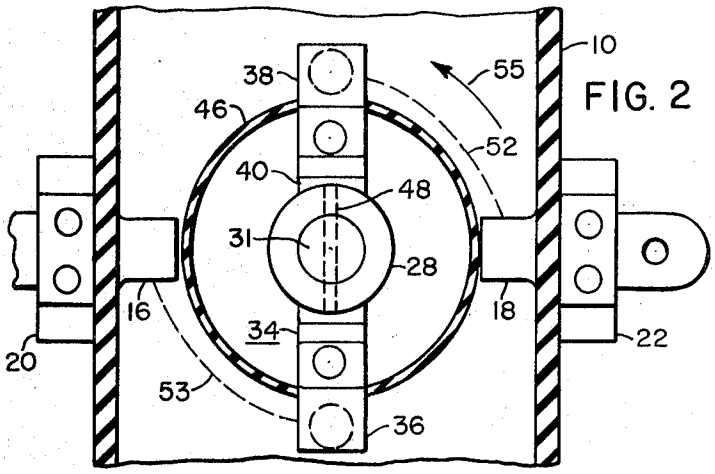


FIG. 2

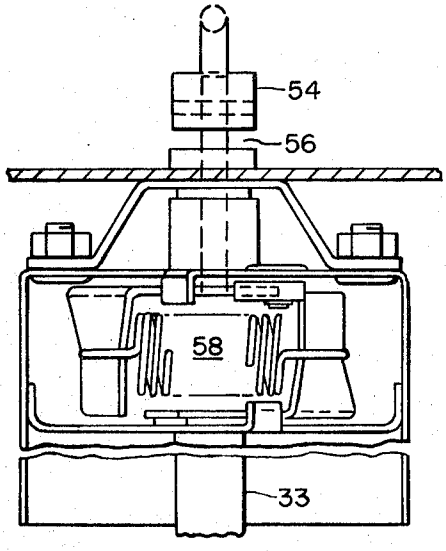


FIG. 3

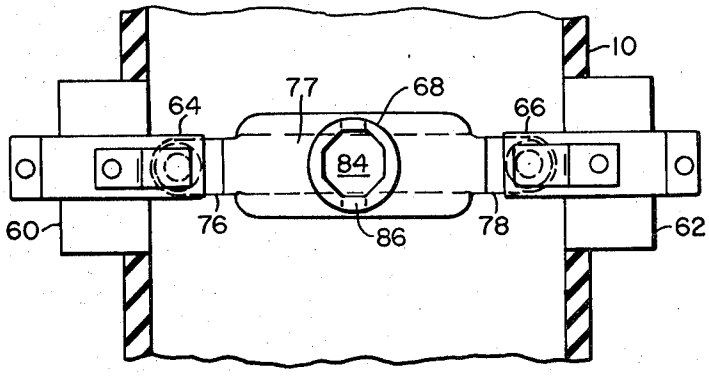


FIG. 5

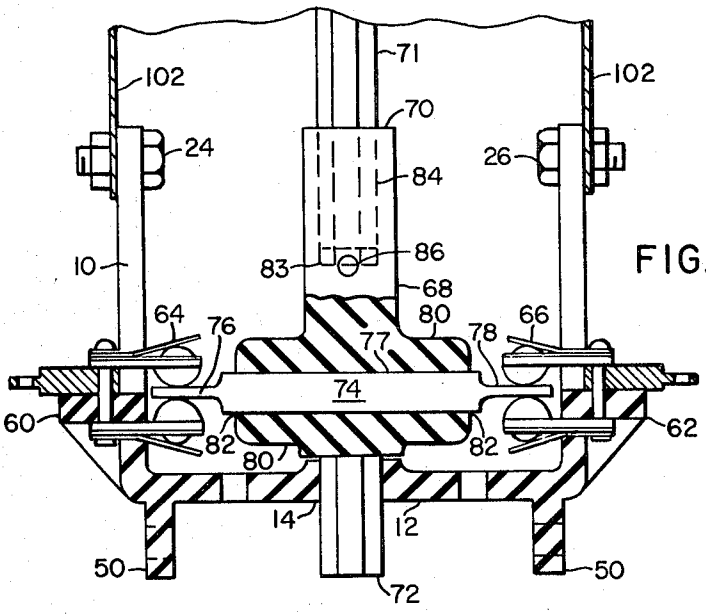


FIG. 6

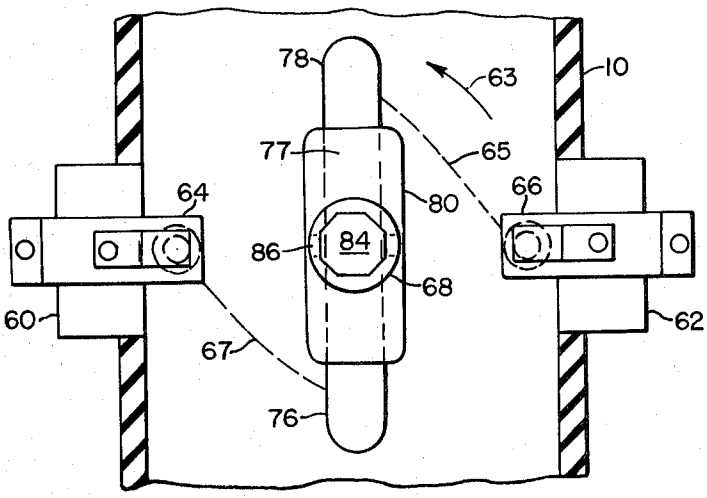


FIG. 7

ROTARY ELECTRICAL SWITCHING CONTACT ASSEMBLY WITH HOLLOW INSULATING ARC BARRIER

CROSS-REFERENCE TO RELATED APPLICATIONS

Title, "Quick-Make and Quick-Break Switch;" Inventor, Merrill G. Leonard; filed July 31, 1967; Ser. No. 657,114 now Pat. No. 3,590,183.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates in general to electrical switching contact assemblies for electrical apparatus, such as power distribution transformers, and more particularly to electrical switching contact assemblies of the type which may be stacked for polyphase switching operations.

DESCRIPTION OF THE PRIOR ART

The increasing use in recent years of underground distribution systems has necessitated the development of auxiliary devices which must be a part of the distribution system. The load break switch is frequently used in underground distribution systems to electrically disconnect the load on the distribution transformer. It is mounted either within the transformer compartment with an external means for actuating the switch or in the associated switching apparatus connected with the underground distribution system.

Initially, switching requirements as high as 200 amperes at 7,200 volts single phase were seldom exceeded, and existing equipment was able to meet these requirements. New underground distribution systems are being designed which will require load break switches capable of disconnecting the load of the distribution transformer at a potential of up to 23,000 volts in the grounded wye three phase connection with a current as high as 330 amperes. Tests on present load break switches have indicated that operation at this level is inadequate because of the arc persisting characteristic when the load is broken. During a load break operation at these high ratings, an arc develops between the stationary contacts and the movable contacts and travels from the movable contacts to the movable contact carrier. The arc persists between the movable contact carrier and the stationary contacts even when the movable contacts are in the extreme open position. Because of the arc persisting properties of present load break apparatus at the high ratings required by new distribution systems, the present apparatus has been found to be inadequate and new and more efficient devices were found necessary.

SUMMARY OF THE INVENTION

This invention is a new and improved electrical switching contact assembly which will operate satisfactorily at the high ratings required by modern underground distribution systems. Experimental tests have shown that the contact assembly is satisfactory up to a rating of 23,000 volts and 330 amperes in a grounded wye three phase connection.

The invention utilizes an arc barrier cover, constructed of an insulating material, and attached around the movable contact assembly. The purpose of the arc barrier is to insulate the stationary contacts from the conducting member of the movable contact assembly. While an arc develops between the stationary contacts and the movable contacts in the disconnect operation, the arc is restricted from moving along the conductor assembly because of the insulating properties of the arc barrier. Without the arc barrier the arc would travel to the center of the movable contact assembly and persist. The insertion of the arc barrier effectively draws the arc into the shape of a segment of a circle. The magnetic field generated by this shape helps extinguish the arc. The effective length of the arc is increased by the insertion of the arc barrier, thus aiding in arc extinguishing.

The arc barrier is circularly designed so that friction from the dielectric medium adjacent the arc barrier is kept to a minimum. The arc barrier extends a sufficient distance below the movable contact assembly to prevent the arc from traveling underneath the arc barrier.

In another assembly the movable contact assembly is embedded in the rotating shaft during the molding process used in constructing the shaft. The rotating shaft is constructed of an insulating material which surrounds the movable contact assembly and insulates it in the region between the movable contacts from the adjacent medium. The insulating effect of the shaft material prevents the arc from traveling along the movable contact assembly during an opening sequence of the switch. Because the effective length of the arc is increased as the contacts move apart, the arc will be extinguished when the movable contact assembly is in the open position.

The housing of the switching contact assembly is constructed in such a manner as to allow stacking of successive units for multiphase switching operations. The ends of the rotating shaft are molded into a specific geometric shape to allow attachment to adjacent shafts when the switching units are stacked.

BRIEF DESCRIPTION OF THE DRAWINGS

Further advantages and uses of the invention will become more apparent when considered in view of the following detailed description and drawings, in which:

FIG. 1 is an elevational view, partially in section, of the switching contact assembly of the invention showing the placement of the arc barrier around the movable contact assembly;

FIG. 2 is a top view of the electrical switching assembly with the movable contacts in the open position;

FIG. 3 is an elevational view, partially in section, of a snap-action type contact rotator;

FIG. 4 is an elevational view, partially in section, illustrating the stacking arrangement of three switching assemblies;

FIG. 5 is a sectional view of the top of a contact assembly showing the molded type movable contact assembly in the closed position;

FIG. 6 is an elevational view, partially in section, of a switching contact assembly with a molded type movable contact assembly shown in the closed position; and

FIG. 7 is a sectional view of the top of a switching assembly showing a molded type movable contact assembly in the open position.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Throughout the following description similar reference characters refer to similar members in all figures of the drawings.

Referring now to the drawings, and FIG. 1 in particular, there is shown an electrical switching contact assembly constructed according to the teachings of this. The switching assembly is mounted in a housing **10** which is constructed from an insulating material. The housing **10** includes a base plate **12** with a circular opening **14**, mounting brackets **50** and shoulder members **20** and **22**. Stationary contacts **16** and **18** are attached to the shoulders **20** and **22**, respectively. The contacts **16** and **18** are substantially flat and constructed of a conducting material, such as copper, and are secured to the shoulders **20** and **22** by suitable means, such as rivets or screws. The base plate **12** has lower projecting members **50** which are used to connect two or more housings together. Bolts **24** and **26** are used to attach the housing **10** to similar housings or to a switch actuating mechanism.

A longitudinal rotating shaft **28**, with first and second ends **30** and **32**, respectively, is disposed in the housing **10** with the lower end **32** extending through the opening **14**. There is a circular opening **31** at the upper end **30** of the shaft **28**. The opening **31** permits attaching the rotating shaft **28** to the shaft **33** which may be associated with another switching assembly or with an actuating mechanism. Pin **48** is inserted through shafts **33** and **28** so that the shafts **33** and **28** may be rotated together.

A movable contact assembly **34** is attached to the shaft **28** by screws **44** and a collar **42** which may be an integral part of the shaft **28**. Contacts **36** and **38** are attached at each end of the movable contact assembly. Each of the contacts consists of two hemispherical members **35**, made from a highly conducting material such as silver, and are attached to a conducting bar **40** by a resilient conducting member **41**. The conducting bar **40** furnishes an electrically conducting path between the two contacts **36** and **38**.

The movable contact assembly **34** is attached to the rotating shaft **28** and is moved to engage and disengage the movable contacts with the stationary contacts when the shaft **28** is rotated to closed circuit or open circuit position.

An arc barrier **46** is constructed of an insulating material and disposed around the shaft **28** and over the movable contact assembly **34**. The arc barrier **46** may be constructed in a tapered cylindrical shape and attached to the shaft **28** by pin **48**. The diameter of the arc barrier is large enough to cover the conducting bar **40** and the inner parts of the contacts **36** and **38**. Slots in the arc barrier **48** permit the protrusion of the contacts **36** and **38** from inside the arc barrier **46**. The arc barrier extends a sufficient distance below the movable contact assembly **34** to prevent arcing under the arc barrier.

FIG. **2** shows a top view of the switching assembly of FIG. **1**, with the contacts in the open position. Arrow **55** illustrated the direction of rotation of the shaft **28** and the movable contact assembly **34** during the breaking or opening sequence. An arc develops between contacts **38** and **18** as soon as they lose mechanical contact during an opening sequence under load. A similar reaction occurs between the contacts **16** and **36**. As the distance between the contacts increases, the arc lengthens. The length of the arc is dependent on the properties of the dielectric between the contacts, the electrical loading, and the shape of the arc path. As the contact assembly **34** rotates, the end of the arc which developed on contact **38** has a tendency to travel onto the conductor bar **40** and toward the rotating shaft **28**. Tests have indicated that without the arc barrier **46**, and operating under conditions representative of high voltage distribution systems, an arc develops during the breaking sequence and persists between the stationary contacts **16** and **18** and the central portion of the conductor bar **40**. This persisting arc is damaging to the switching assembly and the associated circuitry as well as being a safety hazard.

By inserting the arc barrier **46** around the movable contact assembly as taught by this invention the arc cannot move along the conductor bar **40** and must remain outside the arc barrier. Arc paths **52** and **53** illustrate the circular shape of sustained arcs. Because the length of the arc path is increased, and due to the magnetic force associated with a circular arc, the arc extinguishing characteristics of the switching assembly taught by this embodiment of the invention exceeds those of the device without the arc barrier in place. Experimental results have indicated that an arc does not persist between the stationary and movable contacts when operated at typical distribution power levels with the arc barrier in place.

Although other designs and shapes for the arc barrier may be used to suppress the arc, the cylindrical shape described in this embodiment is advantageous because viscous friction with the adjacent medium is kept to a minimum. Minimizing the friction aids in reducing the opening time and arc endurance.

FIG. **3** shows an elevational view of an actuating mechanism which may be connected to the switching assembly. Rotating handle **54** turns shaft **56** and engages the snap-action type assembly **58**. The snap-action assembly **58** is connected to a lower shaft **33** which is coupled to the rotating shaft **28** of the switching assembly.

In FIG. **6** is shown an elevational view, partially in section, of another electrical switching assembly.

The housing **10**, base plate **12**, opening **14**, bolts **24** and **26**, and the mounting brackets **50** are similar to the corresponding members described in the first embodiment of this invention. Housing shoulders **60** and **62** furnish means to mount stationary contacts **64** and **66**. The stationary contacts **64** and **66** are similar to the movable contacts **36** and **38** which are shown in FIG. **1** and described in the first embodiment of this invention. The stationary contacts **64** and **66** are mounted to the housing **10** symmetrically about the opening **14** in the base plate **12**.

A longitudinal shaft **68**, having a first or upper end **70** and a second or lower end **72**, is constructed of an insulating material. A suitable material would be an epoxy compound formulated from bisphenal "A" resin plus hexahydrophthalic anhydride hardner with a dispersed glass fiber filler. Another suitable material would be glass filled polyester. The shape of the shaft **68** permits it to be constructed by machining a suitable

material or by a molding process. The movable contact member **74** includes contacts **76** and **78**, and a conducting member **77**. The contacts **76** and **78** are substantially flat and have dimensions which allow engaging with the stationary contacts **64** and **66** respectively. The movable contacts **76** and **78** may be separate members and attached to the conducting bar **77** or they may be an integral part of the conducting bar **77**. The conducting bar **77** is substantially longitudinal and has a cross-section shape of suitable dimensions to permit adequate current conducting properties. The movable contact assembly **74** is mounted in the rotating shaft **68** with their longitudinal axes perpendicular. The contact assembly **74** may be embedded in the insulating material during construction of the rotating shaft **68** when the molding process is utilized. The movable contact assembly **74** is positioned along the rotating shaft **68** to allow the movable contacts **76** and **78** to engate with the stationary contacts **64** and **66** respectively.

The shaft **68** has a protruding boss **80** which electrically insulates the conductor bar **77** from the surrounding medium. The boss **80** protrudes from the shaft surface to a region **82** on the conducting bar **77**. The region **82** is a sufficient distance from the rotating shaft to prevent arcing between the region **82** and the stationary contacts **64** and **66**.

The first or upper end **70** of the rotating shaft **68** is designed to connect the shaft **68** to an adjacent shaft or an actuating mechanism, such as that shown in FIG. **3**. Although various shapes and methods may be used, FIG. **6** illustrates a method utilizing an opening **84** which has an octagonal cross section and extends to a point **83** within the rotating shaft **68**. A shaft **71**, which may be attached to either a contact assembly or an actuating mechanism, is inserted into the opening **84**. Rotating shaft **71** rotates shaft **68**. A suitable adhesive or cement may be applied to the shafts to prevent backlash. This arrangement eliminates the necessity of any metallic connecting hardware, such as pins, from the arcing area.

A weep hole **86** connects the opening **84** with the dielectric material surrounding the shaft **68** and prevents entrapment of air between the shafts **68** and **71**.

The cross section of the second or lower end **72** of the shaft **68** has an octagonal shape permitting insertion into an adjacent shaft.

FIG. **5** is a top view, in section, of the switching contact assembly of FIG. **6** showing their contacts in the closed position.

FIG. **7** is a top view, in section, of the switching contact assembly of FIG. **6** with the contacts in the open position. Arrow **63** illustrates the direction of contact rotation during the opening sequence. Because of the insulating properties of the protruding boss **80** around the conductor bar **77**, persisting arcs must maintain paths **65** between the contacts **78** and **66** and **67** between the contacts **76** and **64**. However, due to the arc length and the cooling effects of the dielectric medium the arc is extinguished before the movable contact member **74** acquires the fully opened position.

FIG. **4** is an elevational view illustrating three switching assemblies **94**, **96** and **98** stacked for three phase switching operations. Housing members **102** and shaft **100** are associated with an actuating mechanism, such as illustrated in FIG. **3**, for actuating the three phase switching assembly shown in FIG. **4**. An oil level **104** is maintained which places all the metallic connecting hardware such as the members **24**, **26**, **100** and **102**, in the air space above the oil level **104**. This, in effect, eliminates any metallic members from the arcing region except the contact members **64**, **66**, **76** and **78**.

We claim:

1. An electrical switching contact assembly comprising a housing member, said housing member having a base plate with a circular opening, first and second stationary contacts, means disposed on said base plate to attach said first and second stationary contacts symmetrically about said circular opening and in a plane substantially perpendicular to the longitudinal axis of said circular opening, a longitudinal shaft with first and second ends, said first end being constructed to receive rotational torque from an external means, said second end extending into said circular opening, a movable contact assembly with first and second movable contacts, means electrically connecting said first and second movable contacts to each other, means connecting said movable contact assembly to a first position on said longitudinal shaft so that a rotational movement of said longitudinal shaft will move said first and second movable contacts in the plane of said first and second stationary contacts to make or break electrical contact with said stationary contacts, a hollow cylindrical shielding member constructed of an insulating material and having first and second ends, the first end of said shielding member being attached to a second position on said longitudinal shaft, the second end of said shielding member having slots therein, the second end of said shielding member being disposed around said movable contact assembly with said movable contacts extending outwardly through the slots in said shielding member, said shielding member being rotated by said longitudinal shaft together with said movable contact assembly to place said shielding member between said stationary contacts and the portion of said movable contact assembly which is between said movable contacts.

2. The electrical switching contact assembly of claim **1** wherein said first end of said rotating shaft is connected to an assembly to rotate said longitudinal shaft about its longitudinal axis.

* * * * *