United States Patent

[11] 3,591,742

[72] Inventor **Richard L. Hundstad**
Pittsburgh, Pa.

[21] Appl. No. **765,390**
[22] Filed **Oct. 7, 1968**
[45] Patented **July 6, 1971**

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

[54] **SEPARABLE CONTACTS FOR VACUUM CIRCUIT INTERRUPTERS WITH ASYMMETRIC WELD-BREAKING CONTACT CONFIGURATIONS**
5 Claims, 2 Drawing Figs.

[52] **U.S. Cl.** **200/144,** 200/166
[51] **Int. Cl.** **H01h 33/66,** H01h 1/12
[50] **Field of Search** ..... 200/144.2, 165, 166 B, 67 PK; 21c/3509

[56] **References Cited**

UNITED STATES PATENTS

3,036,180	5/1962	Greenwood	200/144 (.2)
3,174,019	3/1965	Jansson	200/144 (.2)
3,327,081	6/1967	Pflanz	200/144 (.2)

FOREIGN PATENTS

914,146	7/1949	Germany	200/144 (.2)

Primary Examiner—Robert K. Schaefer
Assistant Examiner—Robert A. Vanderhye
Attorneys—A. T. Stratton, C. L. McHale and W. R. Crout

ABSTRACT: A vacuum-type circuit interrupter is provided having separable contacts with an asymmetric arrangement, or configuration, which will aid in breaking welds by accomplishing a tearing, or blending action upon the separable contacts at the initial time of contact separation during the opening operation.

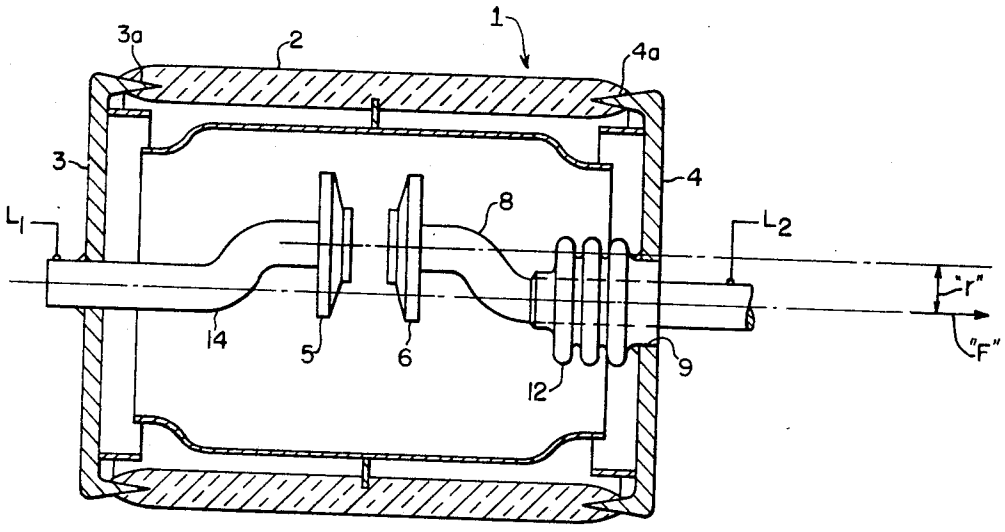
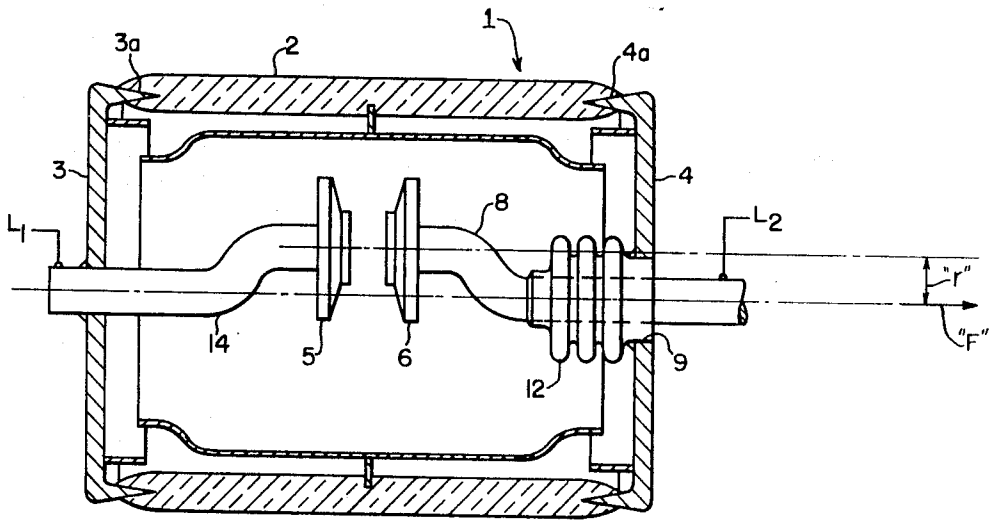


FIG. 1.



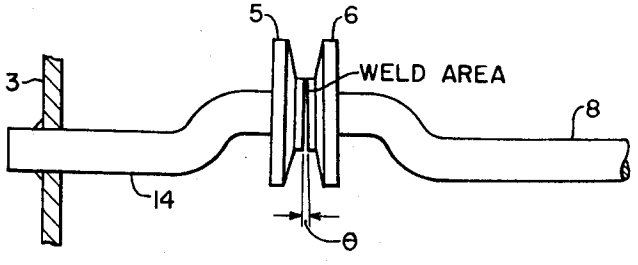


FIG. 2.

WITNESSES

Theodore F. Krobel

James T. Young

INVENTOR

Richard L. Hundstad

BY

Willard R. Crout

ATTORNEY

SEPARABLE CONTACTS FOR VACUUM CIRCUIT INTERRUPTERS WITH ASYMMETRIC WELD-BREAKING CONTACT CONFIGURATIONS

BACKGROUND OF THE INVENTION

The present invention concerns a concept in the design of separable contacts, or electrodes for vacuum interrupters. Specifically, it is the intent of the present invention to suggest a geometrical arrangement of contact or electrode components, which will reduce the severity of the problem of electrode welding.

Contact materials presently being used in vacuum interrupters weld when brought together under high-voltage conditions. The high voltage causes prestrike followed by arcing, melting, and finally welding when the contacts are forced together. The magnitude of the force required to break the weld, so that the contacts can be opened depends upon many factors including the arc voltage, the current, the contact area, which is melted, and surely the most important—the material itself.

Certain investigators have obtained patents on low-weld-strength contact materials, involving metals, such as copper with a small percentage of a metal, such as bismuth. Consider, for example, patents of the type such as Lafferty U.S. Pat. No. 2,975,255 and Lafferty et al. U.S. Pat. No. 3,246,979 as examples of such patents.

The materials covered by the aforesaid patents have a very low mechanical strength, and, thereby, do not have as severe a weld problem. Another partial solution to the weld problem is to choose metals, or combinations of metals, which produce brittle materials at the electrode interface. In general, the approach to the problem of contact welding has been to choose specific metals or combinations of metals, which are mechanically weak, or which produce weak or brittle materials at the reacted interface between the separable contacts.

A disadvantage arises from contact surfaces, which have a low mechanical strength. Lower mechanical strength generally connotes a depressed "high voltage withstand" ability. Also, lower mechanical strength materials are more prone to erosion.

SUMMARY OF THE INVENTION

According to a preferred embodiment of the present invention, a pair of separable contacts are provided for a vacuum-type circuit interrupter in which the contact arrangement is asymmetrically arranged. The line of contact engagement is deliberately provided at an appreciable distance from the line of action of the forces tending to separate the contacts, so that a bending moment occurs which aids in weld breaking. The weld breaking moment is a function of the force pulling the contacts apart and the radius from the line of action of the force to the center of the welded area. A minute counterrotation of the electrodes is required to accomplish the tearing action.

Accordingly, it is a general object of the present invention to provide an improved separable-contact arrangement for vacuum-type circuit interrupters in which an asymmetrical arrangement is provided to provide a bending moment at the time of contact separation and resultant circuit interruption.

A more specific object of the present invention is the provision of an improved vacuum-type circuit interrupter of low welding characteristics.

Still a further object of the present invention is the provision of an improved weld-free vacuum-type circuit interrupter in which a minimum of tensile forces may be required to accomplish the opening operation.

Still a further object of the present invention is the provision of a vacuum-type circuit interrupter of reduced welding characteristics provided by a lateral displacement of the line of action of the weld-breaking area from the line of action of the tensile forces, induced by operation of the operating rod in its longitudinal opening movement.

Further objects and advantages will readily become apparent upon reading the following specification taken in conjunction with the drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a vertical sectional view taken longitudinally through a vacuum-type circuit interrupter showing a separable contact arrangement employing the principles of the present invention, the contacts being shown in the fully open-circuit position; and,

FIG. 2 is a fragmentary view of the contact structure of FIG. 1 at the time of initial contact separation.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawing, and more particularly to FIG. 1 thereof, the reference numeral 1 generally designates a vacuum-type circuit interrupter. As shown, the vacuum-type circuit interrupter 1 comprises a highly evacuated envelope 2 comprising a tubular insulating casing, formed of glass or a suitable ceramic material. Sealed to the ends of the tubular insulating casing 2 is a pair of end plates, or caps 3, 4, which are sealed in a vacuum-type manner to the ends of the tubular casing 2 as at 3*a*, 4*a*. This may be accomplished in a manner well known by those skilled in the art.

The normal pressure within the envelope is lower than 10^{14} mm. of mercury, so that a reasonable assurance is had that the mean free path for electrons will be longer than the potential breakdown paths within the envelope.

Located within the envelope is a pair of relatively separable contacts or electrodes 5, 6, which are shown in FIG. 1 in their separated or open-circuit position. One of the contacts or electrodes 5 is a stationary contact of generally disc-shape, whereas the other separable contact 6 is a movable contact also in the shape of a round disc. When the circuit interrupter is in its closed position, the movable contact 6 engages the stationary contact 5 in a manner generally indicated in FIG. 2 of the drawing. In the closed position, current may flow from the line terminals L_1, L_2.

The movable contact 6 is suitably joined to the end of a conductive operating rod 8. The operating rod 8 projects through an opening 9 provided in the end cap 4, and a flexible metallic bellows 12 provides a seal about the operating rod 8 to allow for the longitudinal operating movement of the rod without impairing the vacuum inside the envelope 2. As shown in FIG. 1, the metallic bellows is secured in sealed relationship at its respective opposite ends to the operating rod 8 and also to the end cap 4.

The stationary contact 5 is mounted upon a conductor 14 of high conductivity material, such as copper. This conductor has an extension at its outer end, that extends through the end cap 3 and serves as one terminal for the vacuum-type circuit interrupter 1. A suitable brazed joint is provided about the extension to maintain the envelope vacuum-tight, and to provide a mechanically strong connection between the end cap 3 and the extension.

As stated hereinbefore, one of the problems in the interruption of vacuum-type circuit interrupters is the welding problem, which must be overcome. All of the vacuum circuit interrupter designs known to me have the electrode stems and contact surfaces geometrically arranged so that the welds, which are formed between the contacts, must be broken by almost pure tension. In other words, the lines of action of the forces, used to pull the contacts apart, are concurrent with the center of the contact area. I propose in my invention that the center of the contact surface area of the electrodes, or contacts be displaced from the line of action of the forces used to separate the contacts. As a result, the welds will be more easily broken because of the combined action of tension and bending, which will produce a localized high stress in the weld, and, thereby, result in a tearing action. By applying the suggested concept, it will be possible to use materials which would otherwise be prohibited because of welding. Generally, it is most

desirable to provide an asymmetrical arrangement, as shown in FIGS. 1 and 2. FIG. 1 shows a generally simple form of the invention which utilizes the proposed concept. The bending moment, which aids in weld breaking, is a function of Fr, where "F" is the force pulling the contacts apart, and "r" is the radius from the line of action of the force to the center of the welded area. It is obvious that a minute counterrotation of the electrodes is required to accomplish the tearing action. This is more clearly illustrated in FIG. 2 of the drawings, which shows the initial time of contact separation with the tearing or bending action illustrated and angle θ indicating such bending action.

It is to be clearly understood that the proposed asymmetrical arrangement may be used in combination with other types of contact configuration, involving slots or spirals, or any other type of contact arrangement. In effect, it may be superimposed upon the proposed contact arrangement to provide the desired offcenter, or asymmetrical bending moment to more clearly break the weld.

Although there has been illustrated and described a specific structure, it is to be clearly understood that the same was merely for the purpose of illustration, and that changes and modifications may readily be made by those skilled in the art without departing from the spirit and scope of the invention.

I claim as my invention:

1. A circuit interrupter of the vacuum-type comprising:
   a. a first electrode;
   b. support means for the first electrode;
   c. a second electrode making physical contact with the first electrode during the closing stroke of the interrupter and thereby defining an intercontact weld-breaking area;
   d. the second electrode separable from the first electrode to establish an arc;
   e. means defining an evacuated envelope surrounding said separable electrodes;
   f. operating-rod means for effecting a separation of said separable electrodes; and,
   g. the line of action of the weld-breaking area being displaced from the line of action of the operating-rod means and also the line of action of the said support means, whereby a bending moment is produced for facilitating the breaking of the weld during the opening operation.

2. The circuit interrupter of claim 1 in which the two separable electrodes and their supporting portions form a laterally bowed current path through the interrupter displaced from the axis of the interrupter.

3. The circuit interrupter of claim 1 in which the electrodes are disc-shaped and the supporting contact stems constitute offset portions.

4. A circuit interrupter of the vacuum-type comprising:
   a. a stationary contact;
   b. support rod means for the stationary contact;
   c. a movable contact separable from the stationary contact to establish an arc;
   d. means defining an evacuated envelope surrounding said separable contacts;
   e. and means including the location of the contact area between the stationary and movable contacts laterally of the line of action of said support rod means for creating a bending movement upon the contact portions during the opening operation to facilitate the breaking of the welds which occur during the opening operation.

5. The circuit interrupter of claim 4, wherein the contacts are disc-shaped and the supporting contact stem portions are laterally offset from the central axis of the circuit interrupter.