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(54) Vacuum switching device

(57) A vacuum switching device has a junction (40; 45) at which a housing (10, 23; 10, 22, 24, 60) of said switching device, a first switching component (11, 13; 12, 14) and a second switching component (15; 16) meet, said junction (40; 45) having a vacuum on one side and a gas on the other, said housing and said first and second switching components comprising locating means (41, 42; 43, 44) for allowing accurate location of said first and second switching components with respect to each other and with respect to said housing. The switching components are, for example, the stem (13; 14) of a fixed or moving contact and an end-stub (15; 16) for making electrical connection between the contact and external equipment. The locating means are, preferably, a male "peg" (41; 43) on the stem and a bored hole (41; 44) in the end-stub, the peg fitting into a corresponding hole in the housing at that point.

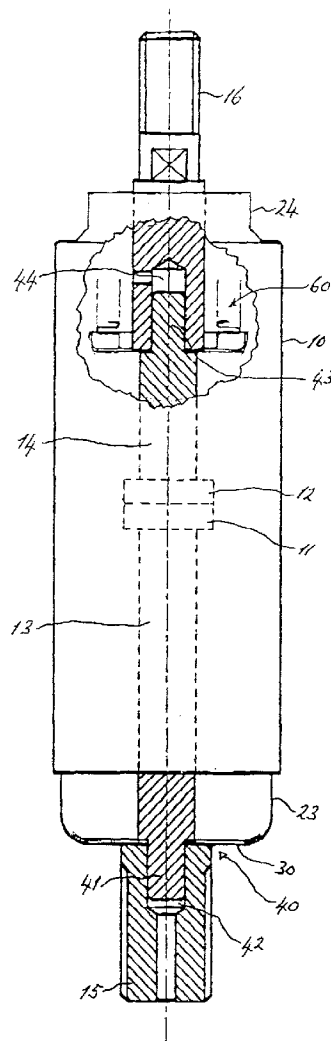


Figure 4

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Description

The invention concerns a vacuum switching device, and in particular, but not exclusively, a vacuum interrupter.

Vacuum interrupters are commonly used in electrical equipment for interrupting an AC supply in the event of a fault, e.g. a short-circuit on a power line. A typical vacuum interrupter is shown in very general terms in Figure 1. The interrupter comprises an insulator 10, normally made of a ceramic material, housing two electrically conductive contacts 11, 12. Contacts 11, 12 are taken out of the interrupter unit by means of respective stems 13, 14, the stems terminating in end-portions 15, 16, normally referred to as "end-stubs", for connection to further electrical equipment (not shown). The end-stubs 15, 16 may have external or internal threads for effecting the connections.

Also included in the interrupter is a bellows unit 17 and a shield 18. The bellows unit 17 allows axial movement of the stem 14 to make and break, selectively, electrical contact between the contacts 11 and 12, contact 11 and stem 13 being fixed relative to the insulator 10.

The shield 18 is an electrically conductive component which serves two main purposes: to prevent an arc, which is drawn when the contacts are separated, from striking the insulator and to impede the deposition of metal vapour, which is given off from the contacts when the arc is present, on the insulator.

It is known, and is generally desirable, to assemble a vacuum interrupter in a single brazing process, in which the various components are positioned as required in an external jig, with brazing discs between those items to be brazed, are heated up to a temperature at which the brazing agent will flow and the temperature then reduced so that the brazing agent solidifies, the components of the interrupter being then set together to form a complete unit.

It is a normal requirement that the various items within the interrupter, e.g. the shield 18 and the switching components constituted by the contacts 11, 12 and the stems 13, 14 and associated end-stubs 15, 16, be disposed as centrally as possible in order to minimise the possibility of imbalance in the electrical stresses set up in the insulator 10 when the contacts 11, 12 part. This implies the need for some form of alignment of these parts, and in the case of the stems 13, 14 and end-stubs 15, 16, this has previously been achieved by, for example, the simple expedient shown in Figure 2.

In Figure 2, a one-piece arrangement of stem 13 and end-stub 15 is illustrated, in which the end-stub 15 is arranged to pass through a clearance-fit hole in the housing on the underside 30 of the interrupter. Where these items meet constitutes a junction at which a vacuum exists on one side (the inside of the interrupter), while a gas, normally air, is present at the other side (the side which interfaces with external equipment). In order to limit movement of the stem and allow accurate axial

placement of the contact 11 in the interrupter, it is necessary to add a shoulder 31 to the stem 13.

There are two disadvantages associated with this solution: firstly, the need for the shoulder 31, which adds unwanted complexity to the unit and increases costs; secondly, the fact that the material on both sides of the housing must needs be the same. This latter factor is a drawback inasmuch as it can be desirable to employ different materials either side of the junction: an oxygen-free, electronic-grade copper for the vacuum side, for example, and a hard copper, e.g. CrCu, for the non-vacuum side. This is to enable external equipment to be reliably screwed to the end-stub 15; when soft copper is used, the thread on the end-stub can easily be stripped.

Another solution to the problem of accurately aligning the switching components has been to employ different materials on the two sides of the junction, which is desirable, as already explained, but to arrange for them to be jigged. Figure 3 shows such an arrangement, in which end-stub 15 and stem 13 are separate items, their centre lines being brought into registration by jigs (not shown) either side of the vacuum wall 30. This, however, has the drawback that the items at the junction must be secured together, e.g. by brazing, in a separate operation, so that the advantages of securing everything in the interrupter at the same time is lost.

In accordance with the invention, there is provided a vacuum switching device having a junction at which a housing of said switching device, a first switching component and a second switching component meet, said junction having a vacuum on one side and a gas on the other, said housing and said first and second switching components comprising locating means for allowing accurate location of said first and second switching components with respect to each other and with respect to said housing.

Said first switching component may comprise a male locating means and said second switching component may comprise a female locating means.

A hole may be provided in said housing for insertion of said male locating means through said housing, said hole having dimensions such as to allow, at room temperature, a clearance fit between the hole and said male locating means.

Said first switching component may be a contact member and said second switching component may be an end-stub for the electrical connection of said contact member to external equipment.

In accordance with a second aspect of the invention, there is provided a method of brazing together components of a vacuum switching device, said device comprising an insulating housing arrangement, first and second end-rings disposed at respective ends of said housing arrangement, a first contact member in locating engagement with a first end-stub and with said first end-ring, and a second contact member in locating engagement with a second end-stub and with a bellows assembly

bly, a brazing agent being provided at interfaces of said components to be brazed together, the method comprising:

- (a) applying a compressive force to said end-rings thereby to ensure a sound joint between said insulating housing arrangement and said end-rings;
- (b) applying a compressive force to said end-stubs thereby to ensure a sound joint between said first end-stub, said first contact member and said first end-ring and between said second end-stub, said second contact member and said bellows assembly);
- (c) subjecting said device to a sub-atmospheric pressure;
- (d) heating said device at said sub-atmospheric pressure until said brazing agent melts, and
- (e) reducing the temperature of said device such that said brazing agent solidifies.

An embodiment of the invention will now be described, by way of example only, with reference to the drawings, of which:

- Figure 1 is a perspective, and partially cutaway, view of a typical vacuum switching device;
- Figure 2 is a cross-sectional view of a typical vacuum/air junction configuration of a vacuum switching device;
- Figure 3 is cross-sectional view of another known vacuum/air junction configuration of a vacuum switching device;
- Figure 4 is a vacuum switching device in accordance with the invention, and
- Figure 5 is a side view in partial cross-section of a jiggling arrangement for the assembly of the vacuum switching device shown in Figure 4.

Referring now to Figure 4, a vacuum interrupter according to the invention is illustrated comprising a pair of contacts 11, 12 on stems 13, 14 with associated end-stubs 15, 16. The contact/stem arrangement is housed in a ceramic housing 10, the stem 13 and end-stub 15 being anchored to the ceramic housing 10 by means of an end-ring 23, while the stem 14 and end-stub 16 are anchored to the same housing 10 by way of a bellows unit 60 (only partly shown) and an end-ring 24.

At a junction 40 of the interrupter the stem 13 has been narrowed to form a male locating means 41 in the form of a "peg", while the end-stub 15 has been bored at its upper end to produce a female locating means 42 which receives the peg 41. The underside 30 of the end-ring 23 is provided with a hole which accommodates the peg 41 and allows accurate alignment of stem 13 and end-stub 15 along the centre-line of the interrupter.

A similar situation exists at the moving-contact end of the interrupter. Thus, the stem 14 is equipped with a narrowed-down portion 43 forming a second peg, while

the end-stub 16 is bored at 44 to accommodate the peg 43.

Clearly, although the two stems 13, 14 have been shown as having the locating pegs, it is also possible for the male and female locating parts to be reversed, so that the end-stubs have the pegs, while the stems are bored to receive them. However, in view of the relative narrowness of the stems compared with the end-stubs, the originally described arrangement of male and female parts is the preferred arrangement.

The procedure for assembling the vacuum interrupter will now be described with reference to Figure 5.

The interrupter is assembled with the aid of a jig 50, which comprises a base 51, three location rods 52 fixed to the base 51 at equidistant points around its circumference and three location discs 53. The lower two discs 53 are maintained at a desired spacing relative to each other by way of spacers 54 (only one of which is shown).

Assembly is commenced by the insertion of the end-stub 15 of the interrupter into the base 51. The fixed end-ring 23 (i.e. the end-ring associated with the fixed contact 11) is then placed on top of the end-stub 15 and the fixed conductor arrangement consisting of the contact 11 and the stem 13 is located in the end-stub 15 with the aid of the peg 41. Next, the ceramic housing 10 is positioned on top of the end-ring 23, being guided by the lower two location discs 53, and a shield arrangement (not shown) is fitted.

The moving conductor arrangement consisting of the contact 12 and the stem 14 is then placed on top of the contact 11 and the bellows arrangement fitted, a plate 22 of the bellows arrangement going first, then the end-stub 16 which is located on the peg 43 of the stem 14, then the bellows unit 60 proper, which is held in position by the upper locating ring 53. The last component to be fitted is the end-ring 24.

It should be understood that, at all the junctions where brazing is to take place, a brazing ring is supplied in series with the components concerned.

Once all the components are in position, a large weight 55 is placed on top of the end-ring 24 to squeeze the outer joints (e.g. the joint 61 between the ceramic housing 10 and the end-ring 23) and a smaller weight 56 is placed on the end-stub 16 to squeeze the inner joints, including the joint at the junction 45 of the end-stub 16 with the stem 14 and the plate 22 and that at the junction 40 of the end-stub 15 with the stem 13 and the end-ring 23.

The whole jiggled assembly is then placed into an oven, which is evacuated down to 10^{-6} mbar and heated to a temperature of up to 800°C, so that the brazing agent melts. The temperature is then allowed to fall, the brazing material then setting and securing all the component parts of the interrupter in one operation.

Claims

1. A vacuum switching device having a junction (40; 45) at which a housing (10, 23; 10, 22, 24, 60) of said switching device, a first switching component (13; 14) and a second switching component (15; 16) meet, said junction (40; 45) having a vacuum on one side and a gas on the other, said housing and said first and second switching components comprising locating means (41, 42; 43, 44) for allowing accurate location of said first and second switching components with respect to each other and with respect to said housing. 5 10
2. A vacuum switching device as claimed in Claim 1, in which said first switching component comprises a male locating means (41; 43) and said second switching component comprises a female locating means (42; 44). 15 20
3. A vacuum switching device as claimed in Claim 2, in which a hole is provided in said housing (23; 22) for insertion of said male locating means (41; 43) through said housing, said hole having dimensions such as to allow, at room temperature, a clearance fit between the hole and said male locating means (41; 43). 25
4. A vacuum switching device as claimed in any one of the preceding claims, in which said first switching component is a contact member (11, 13; 12, 14) and said second switching component is an end-stub (15; 16) for the electrical connection of said contact member to external equipment. 30 35
5. A method of brazing together components of a vacuum switching device, said device comprising an insulating housing arrangement (10), first and second end-rings (23, 24) disposed at respective ends of said housing arrangement (10), a first contact member (11, 13) in locating engagement with a first end-stub (15) and with said first end-ring (23), and a second contact member (12, 14) in locating engagement with a second end-stub (16) and with a bellows assembly (60, 22), a brazing agent being provided at interfaces of said components to be brazed together, the method comprising: 40 45
 - (a) applying a compressive force (55) to said said end-rings (15, 16) thereby to ensure a sound joint between said insulating housing arrangement (10) and said end-rings (23, 24); 50
 - (b) applying a compressive force (56) to said end-stubs (15, 16) thereby to ensure a sound joint between said first end-stub (15), said first contact member (13) and said first end-ring (15) and between said second end-stub (16), said second contact member (14) and said bellows 55

assembly);

(c) subjecting said device to a sub-atmospheric pressure;

(d) heating said device at said sub-atmospheric pressure until said brazing agent melts, and

(e) reducing the temperature of said device such that said brazing agent solidifies.

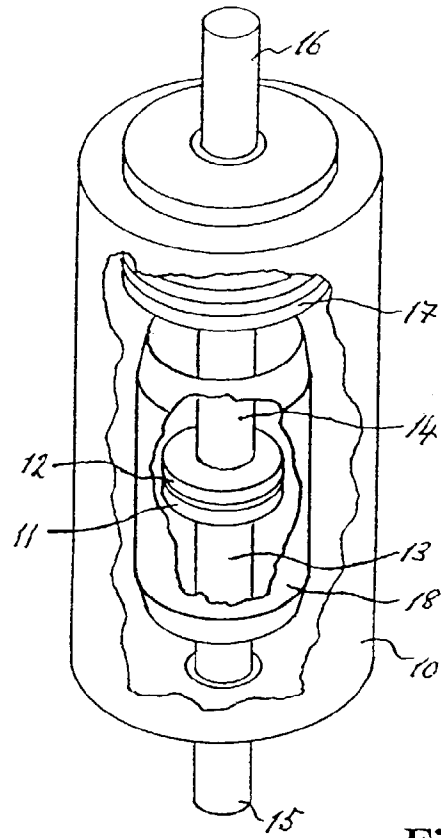


Figure 1

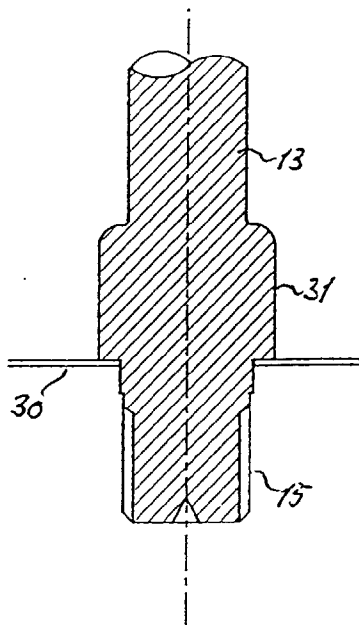


Figure 2

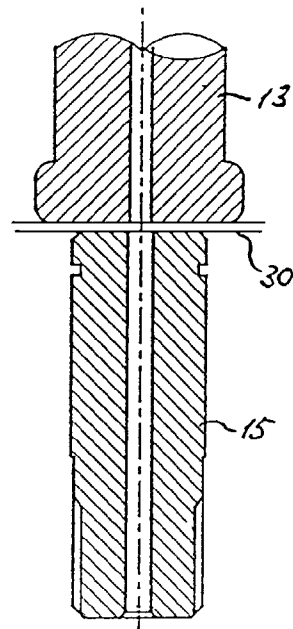


Figure 3

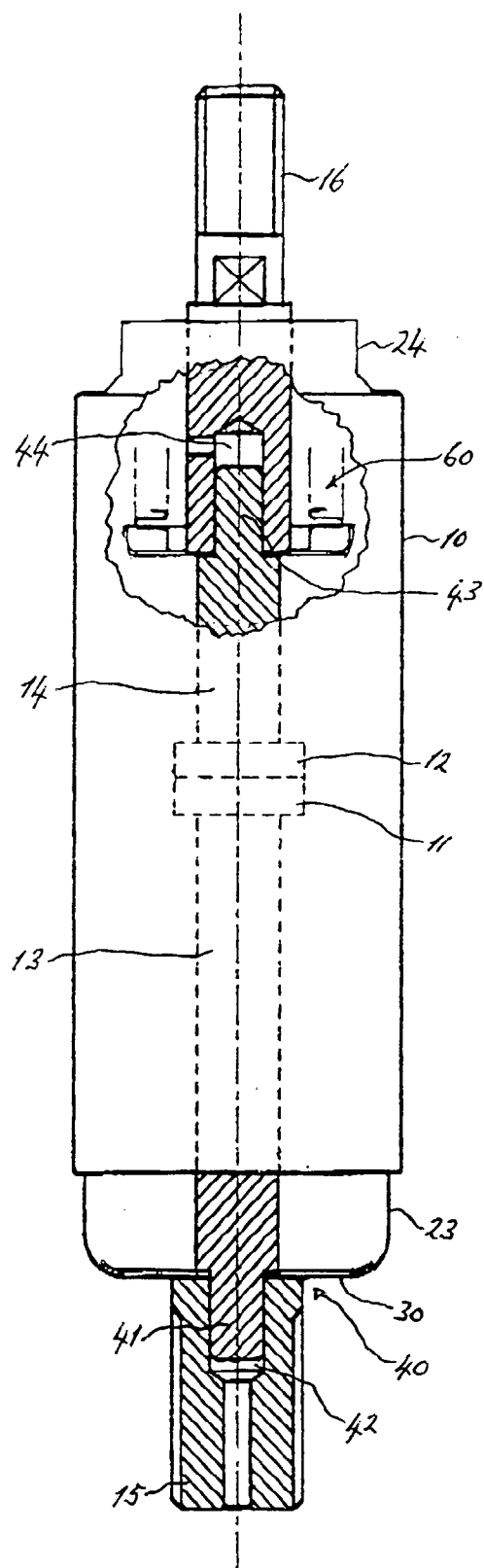


Figure 4

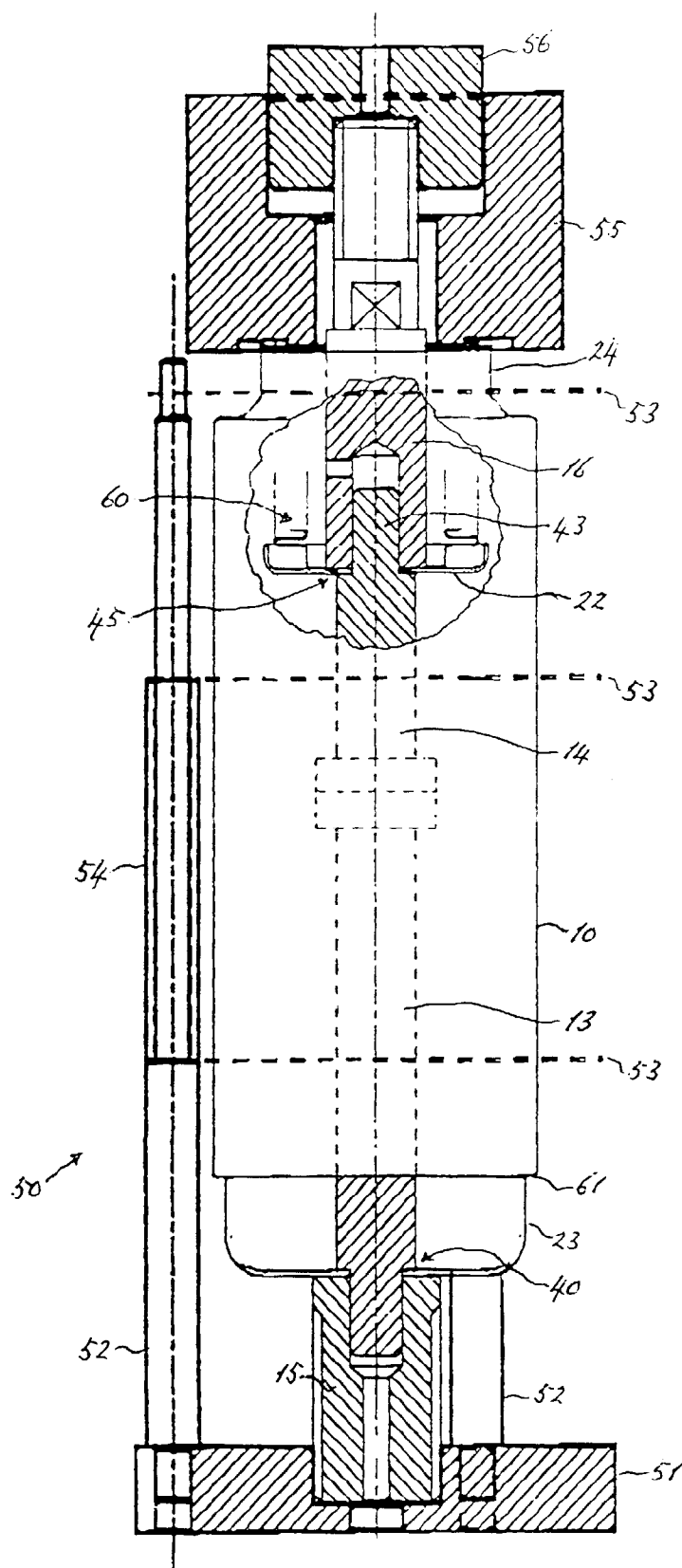


Figure 5