United States Patent

[11] **3,576,960**

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[73] Assignee **General Electric Company**

[54] **FLANGE FASTENING MEANS FOR A CONTACT BUTTON FOR A VACUUM-TYPE CIRCUIT INTERRUPTER**
4 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** **200/144**
[51] **Int. Cl.** **H01h 33/66**
[50] **Field of Search** ..... 200/144.2, 166 (B8), 166 (CM)

[56] **References Cited**

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3,158,719	11/1964	Polinko, Jr. et al.	200/144(.2)
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ABSTRACT: Contact structure for a vacuum-type circuit interrupter comprising a contact containing an annular groove surrounding an integral central boss. An annular contact-making button is fitted in the groove and is secured in place by deforming the outer periphery of the boss to define an integral lip extending radially outwardly from the boss, overlapping a radially inwardly projecting shoulder on the button, and tightly sandwiching the shoulder against the bottom of the groove.

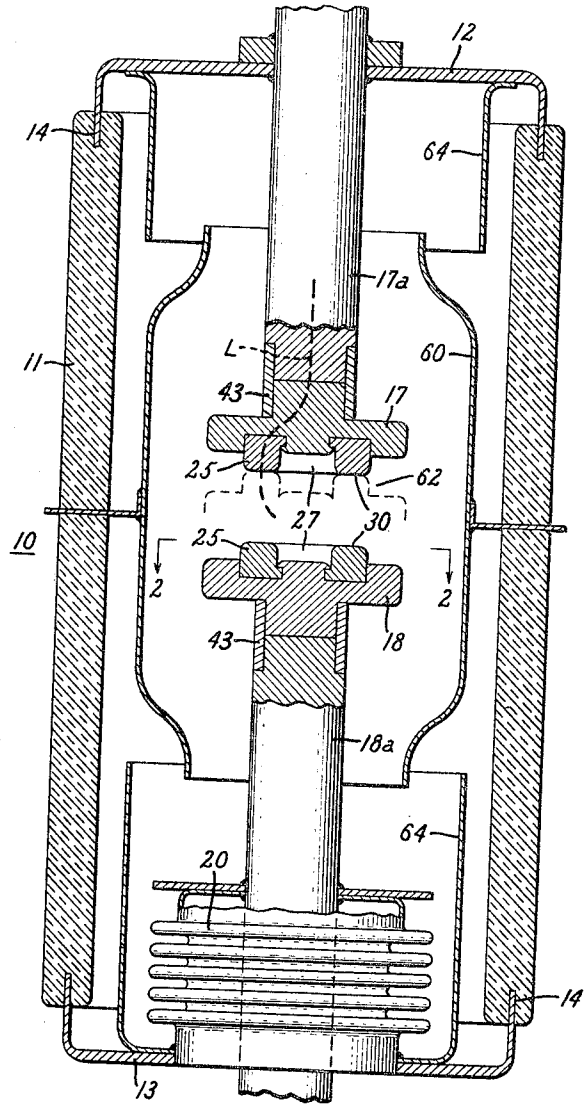


Fig. 1.

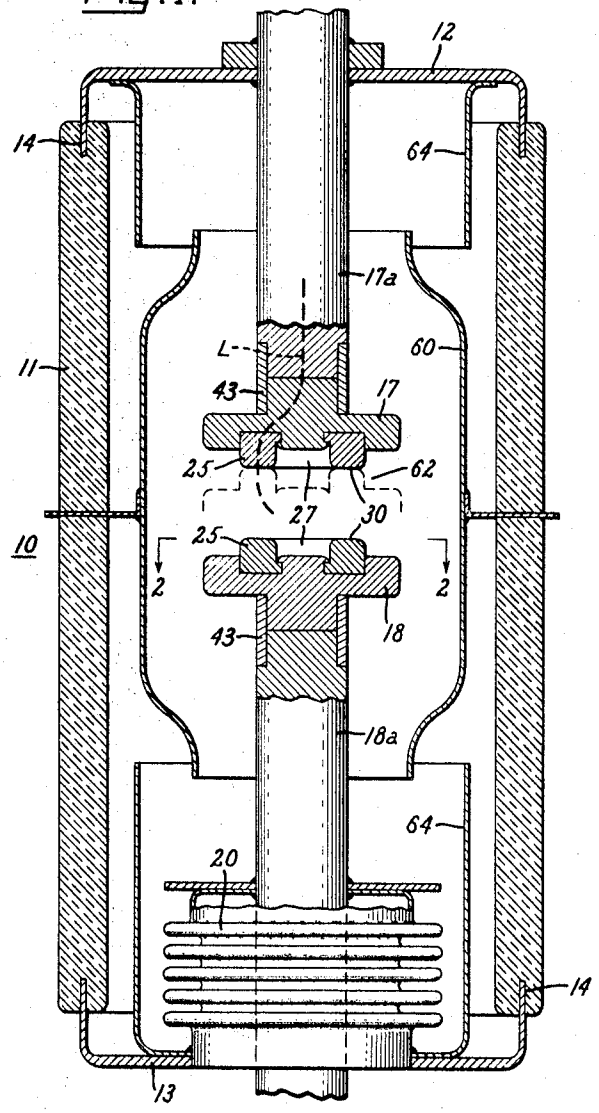


Fig. 1a.

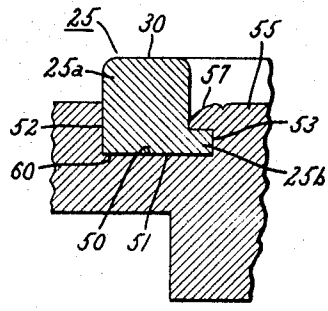


Fig. 2.

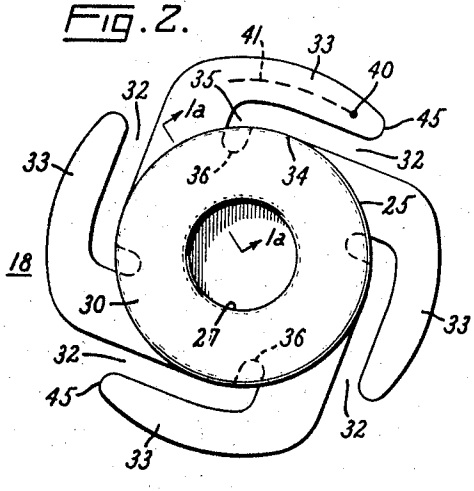
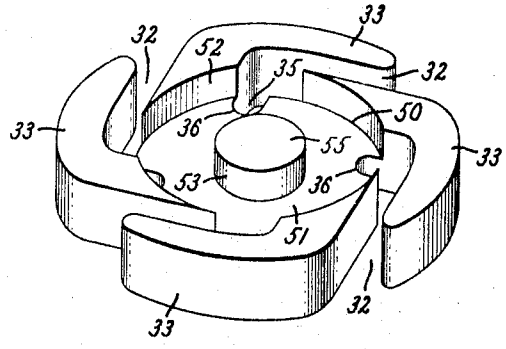


Fig. 3.



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FLANGE FASTENING MEANS FOR A CONTACT BUTTON FOR A VACUUM-TYPE CIRCUIT INTERRUPTER

This invention relates to contact structure for a vacuum-type circuit interrupter and, more particularly, relates to improved means for securing an annular contact-making button to the remainder of the contact structure.

In U.S. Pat. No. 3,182,156—Lee et al. and U.S. Pat. No. 3,158,719—Polinko et al. both assigned to the assignee of the present invention, there are shown vacuum interrupter contact structures which comprise annular contact-making buttons brazed to the remainder of the contact structure. Under certain unusual conditions, there is a possibility that this brazed joint will weaken or fail. To ensure that the contact-making button will not become detached in case of such a weakening or failure, it has been proposed that a more positive supplemental joint be provided about the external periphery of the button.

While this approach is satisfactory for a contact of relatively large diameter, I have found that it has certain significant disadvantages for a small-diameter contact. First of all, for a given diameter contact button, such a supplemental joint requires space which can be acquired only at the expense of the contact surface outside of the button. If the overall contact diameter is small, such space is at a premium and can be relinquished only by sacrificing current-interrupting ability of the interrupter. Secondly, if the brazed joint should fail, causing current to flow through the supplemental joint, the resulting current path configuration would not be well suited for producing the desired radially outward force on the arc during interruption.

An object of my invention is to provide a supplemental joint for the contact-making button which is free from these disadvantages.

In carrying out my invention in one form, I provide an annular groove in one surface of the disc-shaped contact. This groove surrounds an integral central boss and has a base wall and two sidewalls, one sidewall being defined by the outer periphery of the boss. An annular contact-making button is mounted in the groove. This button comprises a main body portion of annular form and an annular shoulder projecting radially inward from said body portion along the base wall of the groove. The outer periphery of the boss is deformed to define an integral lip extending radially outward from the remainder of the boss, overlapping said shoulder and sandwiching the shoulder between said lip and said base wall.

For a better understanding of the invention reference may be had to the following description taken in conjunction with the accompanying drawing, wherein:

FIG. 1 is a side elevational view partly in section showing a vacuum interrupter embodying one form of my invention.

FIG. 1*a* is an enlarged section view along the line 1*a*–1*a* of FIG. 2.

FIG. 2 is a sectional view along the line 2–2 of FIG. 1.

FIG. 3 is a perspective view of the structure of FIG. 2 prior to incorporation of the contact-making button.

Referring now to FIG. 1, there is shown a vacuum-type circuit interrupter comprising a sealed envelope 10 evacuated to a pressure of 10^{-4} torr or lower. This envelope comprises a tubular casing 11 of insulating material and a pair of end caps 12 and 13 joined to opposite ends of the casing 11 by suitable vacuumtight seals 14.

Located within the envelope 10 is a pair of relatively movable contacts 17 and 18, shown by the solid lines of FIG. 1 in their disengaged, or open, position. The upper contact 17 is a stationary contact suitably attached to a conductive rod 17*a*, which at its upper end is united to the upper end cap 12. The lower contact 18 is a movable contact attached to a conductive operating rod 18*a*, which is suitably mounted for vertical movement. Upward movement of contact 18 from its solid-line position to its dotted line position engages the contacts and thus closes the interrupter, whereas return movement in a downward direction separates the contacts and opens the interrupter.

The operating rod 18*a* projects freely through an opening in the lower end cap 13, and a flexible metallic bellows 20 provides a seal about rod 18*a* to allow for vertical movement of the rod without impairing the vacuum inside envelope 10. As shown in FIG. 1, the bellows is secured in sealed relationship at its respective opposite ends to the operating rod 18*a* and the lower end cap 13.

Each of the contacts 17 and 18 is of a substantially circular disc shape and has one major surface, referred to as an arcing surface, facing the other contact. Projecting beyond each arcing surface is a centrally located contact-making button 25 of annular form that is joined to the remainder of the contact in a manner soon to be described.

For accommodating this contact-making button 25, an annular groove 50 is provided in the arcing surface of each contact. Referring to the enlarged view of FIG. 1*a*, this annular groove has a base wall 51 and two spaced-apart sidewalls 52 and 53. Bounded by the groove 50 is an integrally formed central boss 55 that projects toward the other contact. The outer periphery of boss 55 defines the sidewall 53 of groove 50. The contact-making button 25 comprises a main body portion 25*a* of annular form and an annular shoulder 25*b* projecting radially inward from the body portion along the base wall 51 of the groove. The outer periphery of boss 55 is deformed, preferably by a staking operation, to define an integral annular lip 57 that extends radially outward from the remainder of the boss, overlapping the shoulder 25*b*, and tightly sandwiching the shoulder between the lip and the base wall 51.

The contact-making button 25 is brazed to its associated contact along the base wall 51, as indicated at 60. Normally, substantially all of the current flowing through the contact-making button flows through this brazed joint, this being the path of least resistance between the contact-making button and its adjacent contact structure.

Contact between the buttons 25 occurs on an annular contact-making area 30 of each button when the contacts are in their dotted line engaged position of FIG. 1. These annular contact-making regions 30 are of such a diameter that current flowing through the closed contacts follows a radially outwardly bowing loop-shaped path L, as is indicated by the dash line of FIG. 1. The magnetic effect of current flowing through this loop-shaped path L tends in a well-known manner to lengthen the loop. As a result, when the contacts are separated to form an arc between the areas 30, the magnetic effect of the current through the loop will impel the arc radially outward. To make the loop in the loop-shaped path sufficiently pronounced, the diameter of the contact-making buttons is made greater than half that of the disc-shaped contacts.

As the terminals of the arc move toward the outer periphery of the discs 17 and 18, the arc is subjected to a circumferentially acting magnetic force that rotates the arc about the central axis of the discs. This circumferentially acting magnetic force is produced by a plurality of slots 32 provided in each of the discs and dividing the discs into a plurality of fingers 33.

Preferably each of the slots 32 is of the configuration disclosed and claimed in copending application Ser. No. 711,613—Crouch, filed Mar. 8, 1968, and assigned to the assignee of the present invention. Accordingly, each slot 32 extends from the outer periphery of its disc 17 and 18 substantially tangent to the outer periphery of button 25, first touching the outer periphery of the button at a point 34, and continuing tangentially of the button periphery for a substantial distance past 34. At its innermost end, each slot has an inwardly extending portion 35 that is substantially perpendicular to the tangential portion of the slot. This inwardly extending portion 35 extends from the outer periphery of the button to a point 36 spaced radially inward from the outer periphery of the button. As seen in FIG. 2, the button extends across, or bridges, the inwardly extending slot portion 35.

These slots 32 force the current flowing to or from an arc terminal (such as 40 in FIG. 2) on a finger 33 to follow a path (41) through the finger that extends circumferentially of the

disc in the vicinity of the arc. The circumferential component of the current path causes the current flowing through the loop L to develop a net circumferentially acting force component which revolves the arc about the central axis of the disc. This rotational movement of the arc enables higher currents to be interrupted.

Under certain unusual conditions, the brazed joint at **60** may weaken or fail. If this should occur, the lip **57** coacting with the shoulder **25***b*, will prevent the button from becoming detached. In addition, the primary current path will then be through the lip and shoulder. This current path has a much higher resistance than the resistance of an intact brazed joint, and considerably more heating will therefore occur in this region for a given current. Under these circumstances, this heating is quite desirable since it can raise the temperature sufficiently to effect a rebraze of the joint at **60**.

There are a number of important advaNtages gained from locating the staked joint **25***b*, **57** at the inner periphery of the contact-making button. One is that a joint so located requires no space externally of the button **25** which would subtract from the space available for interruption after the arc is driven off the contact-making button. If the overall contact diameter is small, as in the illustrated interrupter, such space is at a premium and can be relinquished only at the expense of reducing the current-interrupting ability of the interrupter. By locating the joint internally of the annular button, I am not required to infringe upon the space external to the button and therefore am able to interrupt more current than if the joint was external.

Another advantage derived from the internal location of the supplemental joint is that if the brazed joint at **60** should fail, causing the primary current to flow through the supplemental joint, the resulting current path configuration is well suited for producing the desired radially outward force on the arc during interruption. In this respect, the current path extending through the supplemental joint **25***b*, **57** to an arc terminal on the contact-making button extends radially outward and therefore provides a pronounced radially outward bowing loop. This is a configuration well suited for producing a radially outward magnetic force on the arc. Had the supplemental joint been located externally of the contact-making button, the current path would have a radially inwardly bowing configuration, which would not be well suited for blowing the arc radially outward.

Another advantage derived from locating the joint internally, instead of externally, of the annular contact-making button **25** is that no portion of the joint is located in the region of the slots **32**. Had the joint been external of the button, the thin shoulder (**57**) that would be on the exterior of button **25** would extend across the slots **32**, and its presence would tend to attract the arc and interfere with the desired high-speed arc motion to the outer periphery of the contact and around the outer contact periphery.

For accentuating the radially outward bow in the current path L, a sleeve **43** of high-resistance material such as stainless steel is provided about each of the contact rods **17***a* and **18***a* where it is joined to the contact structure. These sleeves correspond to identically designated sleeves in the aforesaid Crouch application Ser. No. 711,683.

In a preferred form of the invention, the button **25** is made of a material that has a high resistance to contact welding, e.g., the copper-bismuth or the copper-lead alloys disclosed and claimed in U.S. Pat. No. 3,246,979—Lafferty et al. The remainder of the contact is preferably made of a dissimilar metal which is easy to process, e.g., pure copper.

For condensing the metallic vapors generated by arcing, suitable vapor-condensing shields **60** and **64** are provided. The main shield comprises a tubular member **60** surrounding the arcing gap **62** and located between the insulating casing **11** and the arcing gap. This shield is preferably maintained at a potential substantially midway that of the two electrodes when the circuit interrupter is opened. Auxiliary shields **64** of tubular form connected to the end caps **12** and **13**, respectively, surround opposite ends of the main shield **60**.

While I have shown and described a particular embodiment of my invention, it will be obvious to those skilled in the art that various changes and modifications may be made without departing from my invention in its broader aspects; and I, therefore, intend in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of my invention.

I claim:

1. In contact structure for a vacuum-type interrupter,

a. a pair of separable contacts,

b. one of the contacts being a disc-shaped member having an arcing surface facing the other contact, having an integral central boss, and having an annular groove formed in said arcing surface and surrounding said integral central boss,

c. said groove having a base wall and two spaced -apart sidewalls, one defined by the outer periphery of said boss,

d. an annular contact-making button mounted in said groove,

e. said button comprising a main body portion of annular form and an annular shoulder integral with said body portion and projecting radially inward from said body portion along the base wall of said groove,

f. the outer periphery of said boss being deformed to define an integral lip extending radially outward from the remainder of the boss, overlapping said shoulder, and tightly sandwiching said shoulder between said lip and said base wall to prevent relative movement between said button and the walls of said groove,

g. said contact-making button having an exposed face on the opposite side thereof from said base wall for engaging the other of said contacts, said button carrying current between said base wall and said exposed face when said exposed face engages said other contact.

2. The contact structure of claim **1** in which said other contact is constructed in the same manner as defined in claim **1**, the contact-making buttons of the two contacts engaging each other when the circuit interrupter is closed.

3. The contact structure of claim **1** in which a brazed joint is present between said base wall and the adjacent surface of said contact-making button.

4. The contact structure of claim **1** in which said disc-shaped member contains arc-motivating slots extending radially inward thereof past the outer periphery of said contact-making button and being bridged at their radially innermost ends by said contact-making button, said shoulder and lip being spaced radially inward from the radially innermost ends of said slots.