July 20, 1965 JO EMMETT JENNINGS 3,196,236

HIGH POWER VACUUM CIRCUIT BREAKER CONTACTS AND ARC-EXTINGUISHING MEANS THEREFOR

Filed July 16, 1962 2 Sheets-Sheet 1

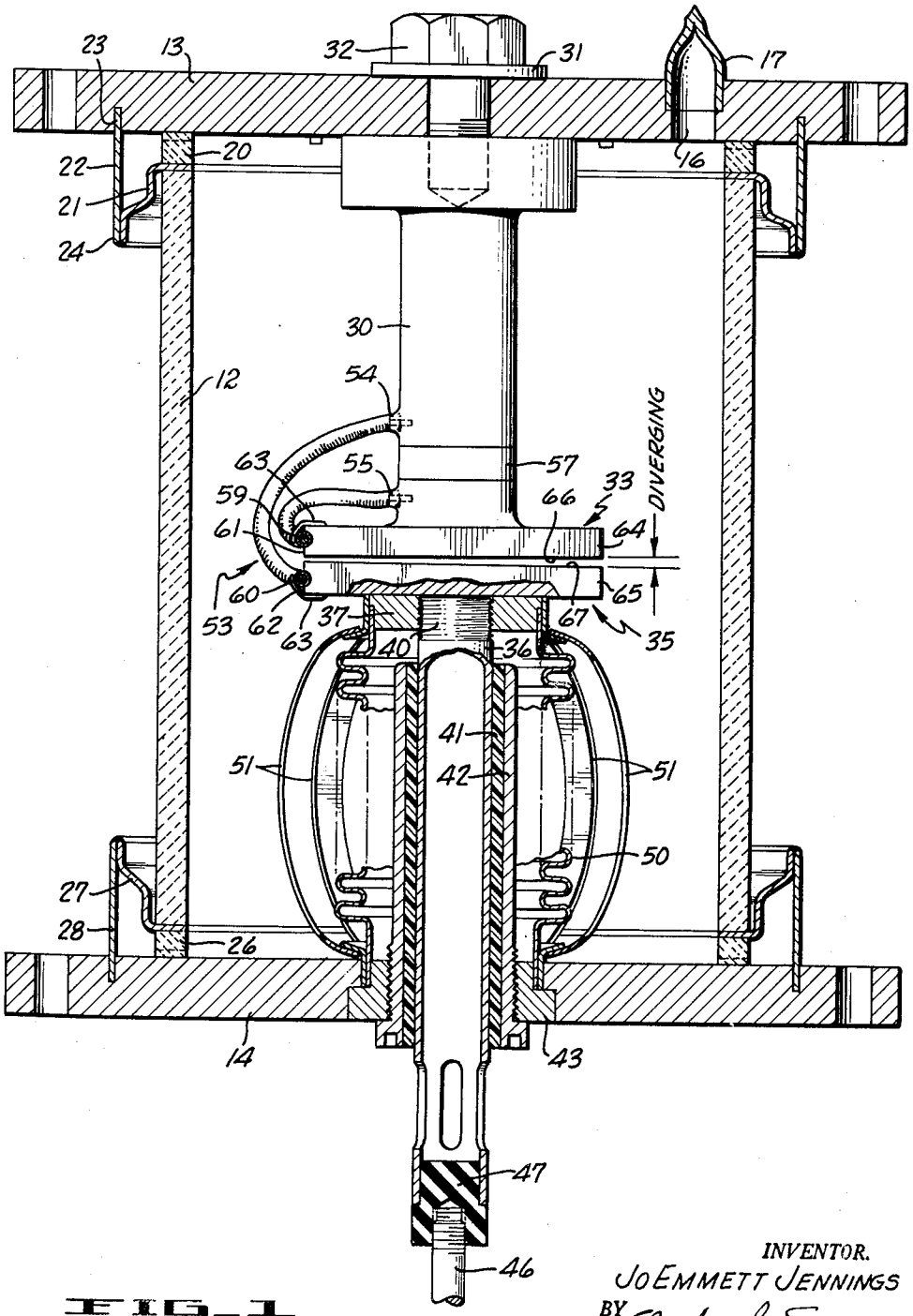


FIG. 1

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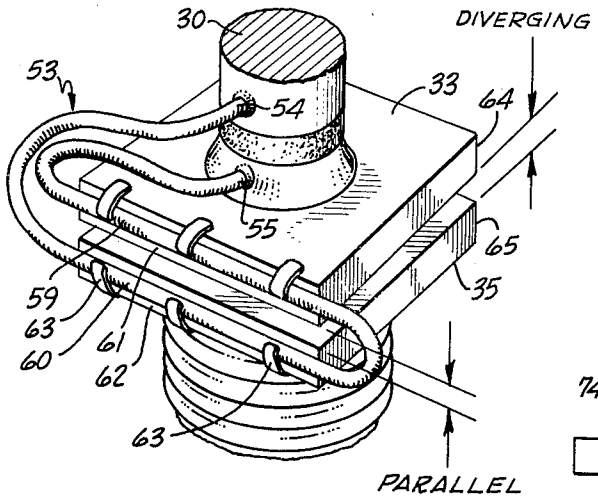


FIG_2

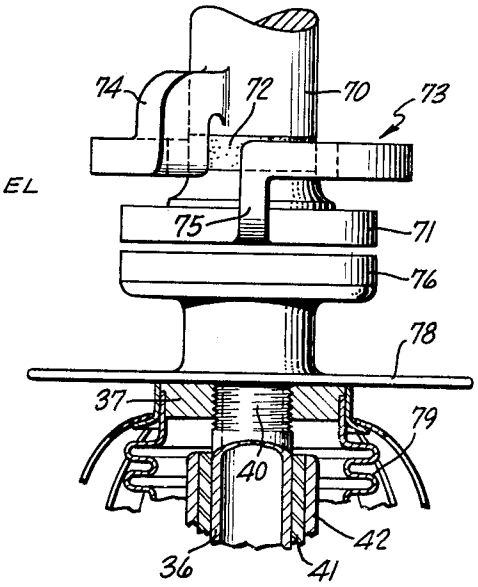


FIG_3

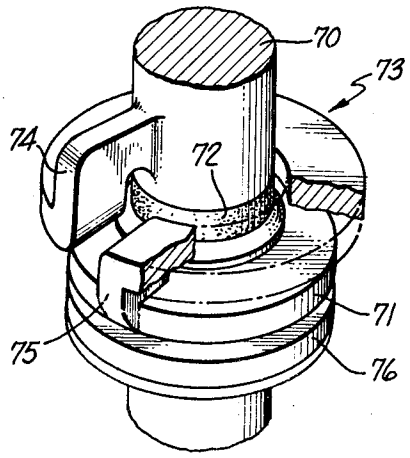


FIG_4

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United States Patent Office 3,196,236 Patented July 20, 1965

3,196,236

HIGH POWER VACUUM CIRCUIT BREAKER CONTACTS AND ARC-EXTINGUISHING MEANS THEREFOR

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4 Claims. (Cl. 200—144)

This invention relates to improvements in vacuum circuit breakers and particularly to improvements in the contacts and the dissipation of the arc therebetween on opening the contacts.

The use of high vacuum circuit breakers for higher current capacities such as of the order upward from 4,000 amperes has been limited in some measure because of the pitting and erosion of the contact surfaces due to arcing.

It is the main object of the invention to provide means for automatically moving the arc formed between engaging contacts during opening of the switch so as to minimize the tendency of the contact surfaces to pit and erode.

Another object of the invention is to provide a switch construction wherein the current carried by the switch automatically creates a magnetic field for blowing the arc along a path of travel between the contact surfaces.

Still another object of the invention is to provide a novel switch contact construction which tends to progress the arc from one side of the contacts to the other thereby minimizing erosion of the contact surfaces.

Another object of the invention is to employ an automatic magnetic field in a vacuum circuit breaker adjacent the contact portions which produces higher magnetic flux as the current is increased.

Still further objects and the entire scope of applicability of the present invention will become apparent from the detailed description given hereinafter. It should be understood, however, that the detailed description and specific examples are given by way of illustration only and, while indicating preferred embodiments of the invention, are not given by way of limitation, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from this detailed description.

For carrying out the various objects and advantages of my invention there is illustrated certain constructions in the drawings in which:

FIG. 1 is a vertical cross sectional view of the vacuum circuit breaker incorporating rectangular contacts and magnetic means in circuit for dissipating the arc from between the contacts on circuit interruption;

FIG. 2 is a perspective of rectangular shaped contacts having diverging surfaces for better arc dissipation;

FIG. 3 is a partial side elevation of another form of contacts with another form of magnetic means in circuit for arc dissipation;

FIG. 4 is a perspective fragmentary view of the contacts and magnetic in-circuit means shown in FIG. 3.

In detail, the invention is illustrated in use in a switch generally designated 10 which includes a vacuumized envelope consisting of a cylindrical shell 12 of ceramic or glass material and a pair of upper and lower end plates 13, 14 respectively.

The envelope is evacuated through a hole 16 formed in end plate 13 and a short tip off 17 which is sealed as the last step in the evacuating process.

To insure the flexibility required to permit expansion and contraction of the parts of the switch housing or envelope an annular ring 20 of glass or ceramic material is interposed between the upper end of cylindrical shell 12 and the upper end plate 13. Ring 20 is not secured to end plate 13 but is metallized for rigid securement by

brazing to the inner marginal portion of an inner annular sealing collar 21 which is also brazed to the upper end of cylindrical shell 12.

A generally cylindrical outer sealing collar 22 is brazed at one end 23 to end plate 13 and at its other end 24 to the outer marginal portion of the sealing collar 21. This structure permits relative shifting of end plate 13 and the shell without imposing stresses on the seals which are required to hold the vacuum.

A similar structure is employed at the opposite end of the switch wherein annular ring 26 and inner and outer sealing collars 27, 28 respectively are employed.

The fixed contact support 30 is secured to the inner side of upper end plate 13 and the latter may be connected to a circuit by means of a terminal strap releasably secured to end plate 13 by a washer 31 and cap screw 32. A rectangular fixed contact plate is indicated at 33 and its particular construction will be described later.

Mobile contact 35 is mounted on the inner end of a mounting stem 36 which may be in the form of a steel tube extending through the lower end plate 14 at its outer end. To facilitate the connection between tubular stem 36 and the mobile contact 35 a centrally apertured plate 37 is fixed to contact 35 and threadedly receives therein the upper threaded end 40 of stem 36.

Mobile contact stem 36 is reciprocably supported within a bearing sleeve 41 of insulating material such as nylon supported in a bearing tube 42 which in turn is screw threadedly received in a bushing 43 fixed to end plate 14. This structure permits the bearing 41 to be removed and replaced if desired without destroying the vacuum in the envelope.

The outer end of tubular stem 36 may be connected to an operator (not shown) by means of an operating rod 46 which may be connected to said stem through an insulating plug 47.

Interposed between end plate 14 and the mobile contact 35 is a bellows 50 which may be secured at its inner end in air tight relation to apertured plate 37 and at its outer end to end plate 14. The outer connection may be conveniently effected by disposing the outer end of the bellows between the outer periphery of bushing 43 and the inner periphery of the opening in end plate 14 that receives said bushing (FIG. 1).

Although some current is necessarily conducted through the bellows 50 from mobile contact 35 to end plate 14, it is preferable to provide a plurality of flexible bonding straps 51 of low resistance extending between plate 37 of the mobile contact and end plate 14 to take substantially all of the current flowing through the switch.

By the present invention the damage to the mobile contact 35 and fixed contact 33 by arcing is substantially reduced by a magnetic blow-out device which, in the structure of FIGS. 1, 2, takes the form of a loop 53 of heavy wire which conducts all of the current flowing through the switch.

As best seen in FIG. 2 loop 53 is connected at one end 54 to the fixed contact support 30 and at its opposite end at a point 55 adjacent fixed contact 33. Interposed between contact support 30 and the contact 33 is a section of ceramic material 57 which is metallized on its opposite sides and fixedly secured by brazing to the adjacent portions of support 30 and contact 33.

It will be noted that loop 53 is formed to provide upper and lower horizontally extending runs 59, 60 which are arranged alongside edges 61, 62 respectively of contacts 33, 35. The wire of loop 53 is provided with insulation and said runs may be held in place relative to the contacts by means of clips 63.

Loop 53 has the effect of creating a relatively strong magnetic field in the gap between contacts 33, 35 as said contacts are opening and any arc formed between said

contacts is subjected to a strong magnetic force urging the same in a direction from edges 61, 62 toward the opposite contact edges 64, 65 (FIG. 1). This "blowing" of the arc along the faces of the contacts inhibits any tendency the arc would have to cause localized pitting or erosion of the contact surfaces.

To further enhance the movement of the arc I may form the contacts 64, 65 so that their opposed contact surfaces 66, 67 diverge from the edges 61, 62 that are adjacent loop 53 toward the opposite edges 64, 65. This structure insures that the arc starts at the points on the contact surfaces that are nearest to each other and proceeds toward the divergent ends at which the arc is dissipated.

A modified form of the invention is illustrated in FIGS. 3, 4 wherein the fixed contact support 70 is connected to the fixed contact 71 by a ceramic spacer 72. In this case instead of a vertically disposed loop such as used in the structures of FIGS. 1, 2, a horizontally disposed loop generally designated 73 is employed. This loop 73 may be formed of copper and made rigid as by brazing one end 74 to contact support 70 above spacer 72 and the other end 75 to contact 71. The fixed contact 71 and mobile contact 76 are, in this case, circular, and the effect of the magnetic field is to blow the arc radially outwardly toward the circular periphery of the contacts. The opposed faces of circular contacts 71, 76 are parallel and the arc tends to start at the center of said faces and expand radially outwardly.

In FIG. 3 there is shown a baffle 78 adjacent mobile contact 76 which may be interposed between said contact and the mobile end of the switch to protect bellows 79.

I claim:

1. In a vacuum switch which includes a vacuumized envelope having fixed and mobile contact structures therein operable to selectively form a gap therebetween, arc blow-out means comprising:

a fixed contact structure including a contact support portion and a contact plate portion,

an insulating spacer forming part of said fixed contact structure and interposed between said contact support portion and said contact plate portion,

a loop of conducting material within the envelope connected at its opposite ends to said contact support portion and said contact plate portion in series circuit therewith to cause current flowing through said fixed contact structure to flow through said loop an intermediate portion of which extends across said gap adjacent one edge of said fixed and movable contacts whereby said loop forms a magnetic field,

means securing the intermediate portion of said loop across the gap formed between said structures whereby said magnetic field exerts a force on an arc formed between said contacts when said switch is opening in order to urge said arc to move within said gap to minimize pitting of adjacent contact surfaces.

2. A switch according to claim 1 wherein said contacts are generally rectangular and of similar shape.

3. A switch according to claim 1 wherein said loop is formed in a plane at right angles to the engaging surfaces of said contact structures.

4. A switch according to claim 1 wherein the engaging surfaces of said contact structures are in divergent planes, said planes diverging in the direction in which said field tends to move said arc.

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