An improved puffer-type compressed-gas circuit-interrupter is provided having the hollow stationary-contact supported adjacent one end of the generally cylindrical chamber, and the stationary fluid directing orifice structure stationarily supported adjacent the other end of the generally cylindrical chamber, with the movable operating cylinder and movable-contact structure linked together, and simultaneously moved toward said other end of the generally-cylindrical operating chamber over a fixed piston.

The construction is such that the gas, compressed by a relative movement of the operating cylinder over the fixed piston, is forced through the stationary insulating fluid-directing orifice member, and then in opposite directions, through the hollow stationary contact structure, and also through the hollow tubular venting movable contact member.

The construction is such that ready assembly and disassembly of the operating parts is achieved by closing the ends of the cylindrical interrupting chamber by end-plate structures, through one of which preferably passes, by a sealed connection, the movable-contact operating rod, connected to the operating mechanism.

The aforesaid operating mechanism for the movable contact rod is preferably disposed exteriorly of the enclosed generally cylindrical chamber for facilitated maintenance.

7 Claims, 10 Drawing Figures
1

PUFFER-TYPE COMPRESSED-GAS CIRCUIT-INTERRUPTER

CROSS-REFERENCES TO RELATED APPLICATIONS

Reference may be made to U.S. Pat. application, filed Nov. 3, 1972, Ser. No. 303,579, entitled "Gas-Blast Circuit Interrupter With Insulating Arc Shield", by Stanislau A. Milanowicz, and assigned to the assignee of the instant application, for general information regarding a generally-similar type puffer-type compressed-gas circuit-interrupter, together with a showing of a fluid-directing orifice structure, which is stationarily mounted.

BACKGROUND OF THE INVENTION

It has been well-known by those skilled in the art to utilize a single-pressure puffer-type circuit interrupter utilizing piston structures for generating gas pressure, and forcing said gas pressure into the arc to effect the latter's extinction.


SUMMARY OF THE INVENTION

According to the present invention, various structural changes have been made in the generally accepted "puffer" designs of the prior art. These changes have been made for facilitated maintenance, and for the prevention of flashover in the open-circuit position of the device. Additionally, the gas-flow paths have been improved to provide more effective arc extinction.

In addition to the foregoing, certain structural changes have been made to effect cost reduction, and to simplify the operating parts.

Accordingly, it is a general object of the present invention to provide an improved puffer-type circuit interrupter utilizing improved constructional arrangements for affording simplified maintenance and more effective interrupting characteristics.

Another object of the present invention is the provision of an improved casing structure and supporting arrangement for a puffer-type circuit interrupter.

Another object of the present invention is the provision of an improved puffer-type circuit-interrupter, in which the isolating gap, in the fully-open-circuit position, is provided in free space, with no creepage surfaces to induce flashover over carbonized surfaces in such fully-open-circuit position.

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

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational view, partly in section, of the improved circuit interrupter of my invention adapted for cube-cell cell operation;

FIGS. 2A and 2B are enlarged vertical sectional views, with FIG. 2A showing the upper portion and FIG. 2B showing the lower portion of the improved puffer-type circuit-interrupter of FIG. 1, the contact structure being illustrated in the closed-circuit position;

FIG. 3 is a fragmentary view, illustrating the parts at an intermediate point in the opening operation, during which arcing ensues;

FIGS. 4A and 4B are views, similar to those of FIGS. 2A and 2B, but illustrating the fully-open-circuit position of the device;

FIG. 5 is a sectional view taken along the line V-V of FIG. 2A;

FIG. 6 is a sectional view taken substantially along the line VI-VI of FIG. 2A; and,

FIG. 7 is a sectional view taken along the line VII-VII of FIG. 2A looking in the direction of the arrows,

FIG. 8 is a view taken on line VIII-VIII of FIG. 2B.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings, and more particularly to FIGS. 1-3 thereof, it will be noted that there is provided a circuit interrupter 1 adapted for roll-in use with a cube-cell 2, having movable primary disconnecting contacts 3, 4, adapted for engagement with stationary primary disconnecting contacts 5, 6, as well known by those skilled in the art. The interrupter 1 is provided with upper and lower plate supports 8, 9, which act as gas-barriers for the casing structure 11, within which is situated the separable contact structure 12. In more detail, there is provided an upper tubular venting stationary-contact structure, generally designated by the reference numeral 16, and comprising a plurality of spaced fingers 18, as more clearly illustrated in the sectional view of FIG. 5. A tubular metallic cylinder 19, surrounds the fingers providing a gas barrier and giving a nozzle effect to the assembly 16. As shown, each finger 18 is bolted by a bolt 21 to the under side of the top plate support 8. It has been found that gas-cooling is accomplished by exhausting the sulfur-hexafluoride gas 20 through the spaced fingers 18 at the upper stationary contact support 8 where the tube 16 is discontinued. It will be noted that the spaced fingers are attached to the upper stationary support plate 8 by a plurality of circumferentially arranged mounting bolts 21. The contact fingers 18 are spread radially outwardly to provide an exhaust area 23 (FIG. 2A) between the many fingers 18, and these spaced contact fingers 18 provide a large cooling heat exchanger. It has been found that, by high-speed movies, that almost all of the gas flow from the puffer exhausts through these spaced fingers 18, and that comparatively little gas exhausts through the hollow moving contact assembly 25, hereinafter described.

Logically, it might be assumed that the place to have intensive cooling would be at the upper support; however, I have accomplished this without the addition of screen, or fins, or area from the walls of the housing 11. It is also an additional advantage to have the lower support 9, as shown, with the operating levers 29 not enclosed in the casing housing 11, as was the construction with prior-art interrupters, such as the type set forth in the aforesaid patent application Ser. No. 51,709.

This provides an arrangement in which the moving-contact rod 30 extends through a seal 31, and gives a positive indication of contact position. Also, the operating levers 29 are easily installed, or worked on, when
they are not enclosed within the gas chamber 11. The seal 31 may be an O-ring or chevron seal as well as a bellows.

The outer casing tube 11 seals to the upper and lower support-plate structures 8, 9 by O-rings, or epoxy, and completes the enclosed chamber 11 for the confinement of a suitable arc-extinguishing gas 20, such as sulfur-hexafluoride gas, for example.

The reference numeral 33 indicates the moving operating cylinder that causes gas 20 to be compressed within the region 36 between the upper moving end 38 thereof and the stationary piston, designated by the reference numeral 40. It will be noted that in the upper end of the operating cylinder 33 are refilling valves 42 of the flapper-type made of spring steel, for example. This results in a simplified valve arrangement compared to the prior-art puffers. The gas is compressed and is driven by the operating cylinder 33 and toward the orifice structure 44, and thereby directed across and through the venting contacts 16 and 25. This particular construction deviates from past design of prior-art circuit-puffer types. Prior-art interrupters found it necessary to have coolers, through which the gas passed before reaching the arc chamber. The improved circuit interrupter of the type set forth in the present application has no need for such cooling structures. Also, in prior-art interrupters, the stationary ring 46 was metallic and electrically connected to the stationary contact structure 16, and thereby caused a different electrical field around the arc than in the present interrupter, as described in FIG. 1, in which the stationary ring-shaped guide 46 is made of insulting material, and is not connected in any manner to the stationary contact structure 16. Because the insulating guide 46 is electrically "floating," there is a much longer open isolating gap when the circuit breaker is open, than in prior-art types of puffer devices, and the problem of tracking between the contacts is therefore minimized. Also, since the stationary ring-shaped guide 46 is not connected to the stationary contact structure 16, there is sulfur-hexafluoride (SF₆) gas 20 in series with the plastic insulation 46 to make tracking over the arc chamber 48 impossible. Because the guide 46 and the stationary contact structure 16 are separate entities, the assembly and disassembly of the interrupter 1 becomes very simple. In 5 minutes, the contacts of the present interrupter can be accessible and can be readily inspected. They are readily accessible to change, whereas the prior-art interrupters might take as long as one-half hour to obtain access to the contacts. The important difference is that the stationary contact structure 16 on the present interrupter can pass through the upper end 38 of the cylinder 33. If the guide 46 and the stationary contact structure 16 were attached together, this would, of course, be impossible. This means that the present interrupter supports the arc chamber 44 and the sealing ring from the lower end 9 of the interrupter on the moving contact support 52. Prior-art puffer interrupters supported this from the upper end of the stationary contact structure.

The arrangement for transferring the current from the moving contact 25 to the moving contact support 52 is different from prior-art interrupters. A corrugated contact sleeve 54 is employed, and found to be very suitable for transferring current across a joint, while motion is taking place. This type of contact is far superior to the type utilizing spring-loaded balls, because the surrounding construction is simplified, and the assembly is made much easier. With reference to FIG. 7, it readily may be seen that a cross-section of the contact sleeve 54 provides many contact points. Additional wedges 56 are used to adapt the sleeve 54 to the diameter of 25. The sleeve 54 transfers current from the moving contact 25 to a short piece of pipe 58. The pipe 58 has four straps 52 bolted to it that carry the current to the lower contact support plate 9. It is to be noted how the bolt-heads 62, that connect the straps 52 to the pipe 58, rest in the corrugations 54a of the sleeve 54, as seen more clearly in FIG. 7.

The current path can be traced from the stud 64 (FIG. 1), which is bolted to the upper support 8, through the fingers 18 of the stationary contact 16, into the copper-tungsten tips 18c of the finger ends, into the moving contact 25, and into the lower contact sleeve 54, and into the short pipe 58 with the four legs 52, down to the lower contact support 9, and back out through the lower contact stud 66. The studs 64, 66 receive finger clusters 68, 70, that allow the interrupter 1 to be plugged into a cell 2.

The design of the tungsten tips on both the moving and stationary contacts are non-conventional, due to the sharp step and lack of the previously-required smooth transition between the tip and the copper. A smooth transition makes a flow guide for the moving gas with minimal turbulence. However, designing a smooth transition into the contact is a wasted step, because after a few interruptions, the copper will erode more than the tungsten tip, and the breaker will erode its own step. I believe that the tip should form a step by design, and the protrusion of the tungsten prevents the production of copper vapor, that would come if there were a smooth transition. This copper vapor can only hinder interruption. It is also my contention that the added turbulence is of insignificant consequence.

The following list of novel features briefly summarize the interrupter details described above.

1. Sulfur-hexafluoride gas cooled by a "bird cage" formed by the spaced radially-arranged contact fingers.
2. Elimination of coolers in a puffer chamber.
3. Supporting the arc shield from the lower end of the interrupter, rather than from the upper end of the interrupter.
4. Using a contact sleeve for linear-moving current transfer, and supplying this to the present interrupter equipment.
5. Utilizing stepped tungsten-alloyed tip contacts.
6. Tracking between the electrodes, or contacts, is now prevented by putting sulfur-hexafluoride gas in series with the plastic insulation of the guide ring.

From the foregoing description, it will be apparent that there has been provided an improved puffer-type circuit interrupter capable of ready assembly and disassembly, by fixedly mounting the relatively stationary contact structure 16 to one end cover-plate portion 8 of the interrupter, and arranging the fixed piston support 52 and the orifice structure 40 adjacent the other end of the interrupter. Additionally, the provision of the moving contact rod 30 through a sealed opening in one end of the interrupter casing 11, and operating it by a mechanism linkage 72, disposed externally of the casing 11, provides ready accessibility and inspection of the operating linkage 72.
Additionally, the cooling feature, involving the radially disposed stationary contact fingers 18, and the provision of an isolating break-gap 74 (FIG. 4A) in free space between the stationary venting contact 16 and the guide ring 46, formed of insulating material, results in no likelihood of flashing over carbonized surfaces.

Finally, the current-transfer arrangement between the tubular venting movable contact and the hollow stationary contact support 52, by the corrugated sleeve arrangement 54, results in ready current transfer without undue heating therebetween.

Although there has been illustrated 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 therein by those skilled in the art, without departing from the spirit and scope of the invention.

I claim:

1. A gas-blast puffer-type circuit-interrupter including a longitudinally extending insulating casing having a first end and an oppositely disposed second end, means at least partially of metal closing said first end of the casing and stationarily supporting therewithin a generally tubularly shaped stationary contact structure, a combined stationary fixed piston and hollow orifice structure fixedly supported from the other second end of the insulating casing, support-rod means extending longitudinally interiorly of said insulating casing to fixedly support said combined fixed piston and hollow orifice structure from the second end of the insulating casing, a movable tubular venting contact linearly movable and operable from the second end of the casing through said combined fixed piston and orifice structure and into and out of contacting engagement with said generally tubularly shaped stationary contact structure, a movable operating cylinder (33) operatively mechanically linked to the movable contact adjacent the second end of the casing and having an annularly-shaped closed-end portion (38) encircling said generally tubularly shaped stationary contact structure, said movable operating cylinder (33) during the opening operation compressing gas and forcing the compressed gas to flow into the tubularly shaped stationary contact structure and also in the opposite direction through said combined fixed piston and hollow orifice structure and then into the interior of the moving tubular venting contact for arc-extinction purposes, the outer peripheral portion of the fixed piston and hollow orifice structure being wholly composed of insulating material so that in the fully-open-circuit position insulating gas is interposed between said peripheral portion of the fixed piston structure and said stationary tubular contact to thereby eliminate creepage and arc tracking over insulating surfaces and thereby avoid electrical breakdown.

2. The gas-blast puffer-type circuit-interrupter of claim 1, wherein the generally tubularly shaped stationary contact structure comprises a plurality of circumferentially spaced-apart stationary contact fingers having venting spaces provided therebetween for the venting of the arc gases.

3. The gas-blast puffer-type circuit-interrupter of claim 1, wherein both ends of the casing are sealed to retain gas therein, and the movable tubular venting contact is operated by an operating rod (30) extending out of the second end of the casing through a sealed opening.

4. The combination of claim 1, wherein the hollow orifice structure is corrugated.

5. The combination of claim 1, wherein one way-acting valve means are provided in said annularly shaped closed-end portion (38) for gas-circulation purposes.

6. The combination according to claim 2, wherein a surrounding metallic tube (19) is provided about the spaced contact fingers to more effectively direct the exhaust arc gases through the stationary contact during the opening operation.

7. The gas-blast puffer-type circuit-interrupter of claim 1, wherein at least one of the ends of the insulating casing is closed by a generally U-shaped plate means.