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[33] **Germany**
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[54] **LIQUID-POOR POWER CIRCUIT BREAKER**
4 Claims, 1 Drawing Fig.

[52] **U.S. Cl.** ..... **200/150 B**
[51] **Int. Cl.** **H01h 33/68**
[50] **Field of Search** ..... 200/150 B, 150 G, 148 E

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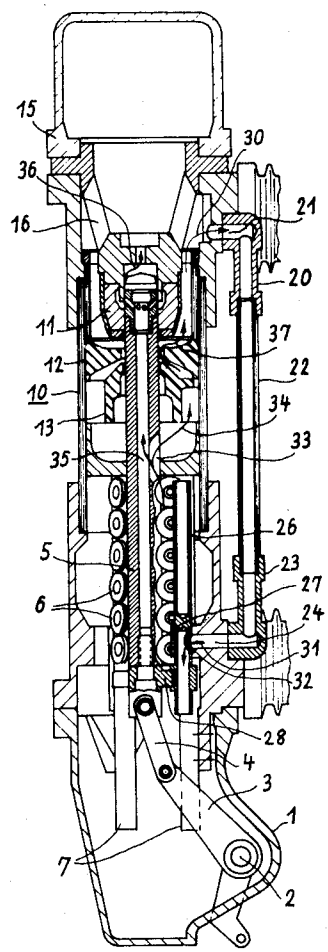
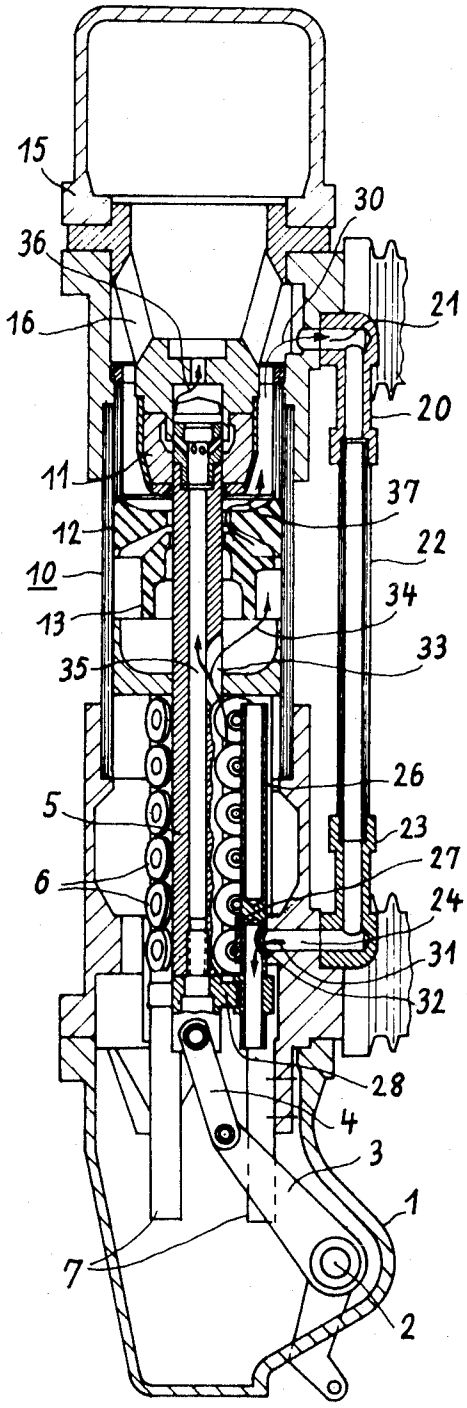
ABSTRACT: The liquid-poor power circuit breaker has a vertical pole column composed of a metallic mechanism housing, a switching chamber above the housing, and a metallic switching head on top of the chamber. A circulatory system for quenching liquid includes a thin insulating tube between the switching head and the mechanism housing outside of the switching chamber. A slider coupled with the movable switch pin of the power breaker blocks the insulating tube when the switch pin is in the break position.

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LIQUID-POOR POWER CIRCUIT BREAKER

Our invention relates to a liquid-poor power circuit breaker having a vertical column composed of a metallic mechanism housing, a switching chamber above the housing, and a metallic switch head on top of the switching chamber. The circuit breaker is provided with a circulation system for circulating quenching-liquid by thermosyphon action. The switching head and the mechanism housing are connected outside of the switching chamber by means of a thin tube made of insulating material, the tube being thin in relation to the switching chamber. The tube enables the circulation system to include a path outside of the switching chamber. This arrangement enables a cooling action to be achieved so that the breaker may be installed with a single switching chamber, that is, without parallel switching chambers, to accommodate the largest rated current in the mid and high voltage area up to the present time.

It is an object of our invention to improve the aforementioned circuit breaker to increase the switching power of the breaker without having a corresponding deficiency in the cooling action. Subsidiary to this object it is an object of our invention to provide such a circuit breaker which is not appreciably more expensive to produce.

According to a feature of the invention, the insulating tube connecting the switching head with the mechanism housing is blocked by a slider when the switch pin of the circuit breaker moves to open the latter, the slider being coupled with the movable switch pin.

With the circuit breaker according to the invention, during the closed position of the breaker, the liquid circulation system stands available for cooling when the current flowing through the circuit breaker introduces heat losses. First in the open circuit condition position is the liquid circulation produced by thermosyphon action interrupted. In this instant, the interior of the switching chamber can be viewed as a sealed space wherein the light arc or a mechanical pumping action can develop the pressure necessary to extinguish the arc without requiring a pressure balance via the insulating tube serving for cooling purposes.

The slider control with a slider coupled with the switching pin requires only a small expense as will be made clear below. Therefore, the instant arrangement is still more practical than a circuit breaker provided with recoil valves at the beginning and end of the insulating tube. Such valves are relatively sensitive with large through passage cross sections and small pressure differences that cause the valves to close.

According to another feature of the invention, the slider member is arranged at the lower portion of the insulating tube and is directly connected with the switching pin. By direct is meant that no connection is provided that influences the movement relationship of the slider and the switch pin. The slider makes the same movement as does the switching pin. A covering over of the upper end of the insulating tube can in most instances be dispensed with since this opening lies in the vicinity of the switching head of the circuit breaker, so that at this location no significant overpressure is to be expected which could damage the insulating tube.

Preferably and according to another feature of the invention the slider is configured as a tubular member having a bore which works together with a bore of the mechanism housing. Preferably and according to another feature of the invention the slider is configured as a tube of which one end is connected to the insulating tube and which works in cooperative relation with a bore of the mechanism housing. The mechanism housing is then used as a portion of the arrangement needed for blocking the flow of liquid. This is achieved by arranging the connecting bore joining into the insulating tube so as to open into a bore corresponding to the cross section of the tube used as a slider. The control of a passage of sufficiently large cross section with a small movable mass is achieved with a slider. In addition the quenching liquid issuing from the insulating tube can be directed to the lower portion of the mechanism housing. In this manner the deepest portions of the circuit breaker that participate in developing heat are

reached with cooled quenching liquid without the necessity of bringing the insulating tube to the deepest location of the mechanism housing.

The invention will now be described with reference to the drawing which illustrates the liquid-poor power circuit breaker of the invention.

The drawing illustrates one pole of a liquid-poor power circuit breaker for medium voltage for example 10 kw. and 4000 A. rated current and is usually constructed as a three-pole assembly. Each pole has a pole column that is vertically positioned and is provided with supporting insulators for mounting on an actuating housing; the latter is not illustrated in the drawing. The pole columns have a metallic mechanism housing **1**. A driving shaft **2** is borne within the housing **1** and passes liquidtight trough the metallic housing. The drive shaft is coupled with a hollow switch pin **5** by a crank **3** and link member **4**. The switch pin **5** is in electrical connection with the current lead-in rods **7** via contact roller pairs **6**.

Above the mechanism housing is disposed a switching chamber **10**. In addition to the already mentioned switching pin **5**, the switching chamber **10** contains a fixedly positioned switching member **11**. The insulating portions **12** and **13** are mounted on the wall of the switching chamber **10** and function to direct the oil required for quenching the light arc that occurs when the circuit breaker opens, the pole column being filled with this oil. The foregoing is described for example in the SIEMENS ZEITSCHRIFT volume 38, Apr. 1964, No. 4, pages 229 to 231.

On top of the switching chamber **10** is secured a switching head **15**. The fixedly mounted switching member **11** is connected with the switching head **15** via a star-shaped carrier **16**. The current flows via carrier part **16** to a not illustrated connection surface on the switching head **15**. A similar connecting surface on the mechanism housing is connected with the switching pin **5** via the current lead-in rod **7**.

A metal elbow **20** is secured to the switching head **15** and has bores which run toward each other at right angles; one bore **21** communicates with the switching head **15** while the other bore communicates with a tube **22** made of insulating material. Tube **22** is spatially disposed parallel to the switching chamber **10** and ends in an elbow member **23** that is configured like the elbow **20** and is connected to a bore **24** of the mechanism housing **1**.

The bore **24** functions in cooperative relation with a tubular body **26** as a slider on the inner side of the mechanism housing **1**, the slider being movable in a direction parallel to the switching pin **5** with the assistance of a guide **27**. The tubular body **26** is starlike coupled with a guiding member **28** through the assistance of two attachments. The guide member **28** is screw connected to the switching pin **5** and constitutes the mounting location for the linking member **4**.

The tubular body **26** together with the wall of the mechanism housing in the region of the bore **24** controls the circulation of the quenching liquid through the tube **22**, the liquid serving to cool the circuit breaker. For the closed position of the switching pin **5** as illustrated in the drawing, the quenching medium heated by means of the heat losses in the circuit breaker can enter the tube **22** from the switching head **15** in the direction of the arrow **30**. The quenching liquid is cooled in the insulating tube **22** because in this region no heat can be developed, whereas, the heat given off to the air surrounding breaker is much stronger than the heat imparted to the switching chamber itself. This occurs among other reasons because the diameter of the insulating tube **22** is substantially smaller than the diameter of the switching chamber. In the illustrated embodiment the insulating tube diameter is only about one-quarter of the switching chamber diameter.

The cooled quenching liquid flows in the direction of the arrow **31** at the bottom end of the insulating tube **22** through bore **24** and a corresponding opening **32** of the tube member **26** in the lower portion of the mechanism housing. The tube member **26** directs the cooled liquid to locations beneath the bore **24** from where the quenching liquid can again travel up-

wardly with increasing heat along the current passover locations between the switching pin **5** and the current lead-in rods **7**. Through slits **33**, the quenching medium also passes between the insulating members **12** and **13** of the quenching chamber as indicated by arrow **34** as well as into the bore **35** of the switching rod **5**. The cooling liquid flows further around the fixedly positioned switching member **11** as indicated by arrow **37** as well as through the switching member as shown by arrow **36** until the warm quenching medium is a region of bore **21** of the switching head **15**.

When the circuit breaker is opened, the tube body **26** moves downwardly directly and simultaneously with the switching pin **5**. Therefore, the bore **24** in the mechanism housing is closed before the point of the switching rod leaves the fixedly position switching member **11**. Now the switching pin **5** extending further into the mechanism housing can develop a pressure that causes a flow of the quenching liquid through the bore of the switching rod **5** and into the switching head. When the light arc is formed, the pressure developed by the quenching liquid decomposed by the arcing action can effectively act in the same direction.

The circulation of fluid is checked in the open circuit position of the circuit breaker of the illustrated embodiment. By means of appropriate openings in the upper region of the tube body, the circulation of the cooling medium in the open circuit position of the breaker can be renewed in the lower portions of the tube body **26** and the switching pin **5**.

In the illustrated embodiment only one tube **22** is illustrated for the circulation of the quenching medium serving also as a cooling liquid, the circulation being controlled by a single tube body **26**. The circuit breaker of the invention can also be configured so that with a single tube body **5**, the lower connections of several insulating tubes arranged parallel to the switching chamber **10** can be controlled on a mechanism housing. In addition, a switching chamber can be provided with several parallel insulating tubes wherein each tube has it own slider.

To those skilled in the art, it will be obvious upon a study of this disclosure that our invention permits of various modifications with respect to features and hence, that the invention may be given embodiments other than particularly illustrated and described herein without departing from the essential features of the invention and within the scope of the claims annexed hereto.

We claim:

1. Liquid-poor power circuit breaker comprising a vertical pole column having a metallic mechanism housing, a switching chamber above said housing and a metallic switch head supported above said switching chamber, circulation means for providing a quenching liquid circulation by thermosyphon action, an insulating tube which is thin in comparison with said switching chamber and which connects said switch head with said mechanism housing outside of the switching chamber, said tube forming part of said circulation means, a slider for selectively blocking and opening said tube, circuit interrupting means disposed in said switching chamber and comprising an axially displaceably switch pin, said slider being coupled with said switch pin to block said tube when said switch pin is in circuit breaking position.

2. Power breaker according to claim **1**, said slider being arranged at the lower end of said insulating tube and being directly connected with said switch pin.

3. Power breaker according to claim **1**, said slider being a tubular member and said mechanism housing having a bore in communication with said tubular slider, said insulating tube having one end connected to said housing bore.

4. Power breaker according to claim **3**, said tubular slider forming a communication for the quenching liquid between the insulating tube and the bottom portion of said mechanism housing.

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