Dec. 29, 1959 A. GANTENBEIN 2,919,330

LOW-OIL CONTENT HIGH-TENSION OIL CIRCUIT BREAKER

Filed Jan. 22, 1957 2 Sheets-Sheet 1

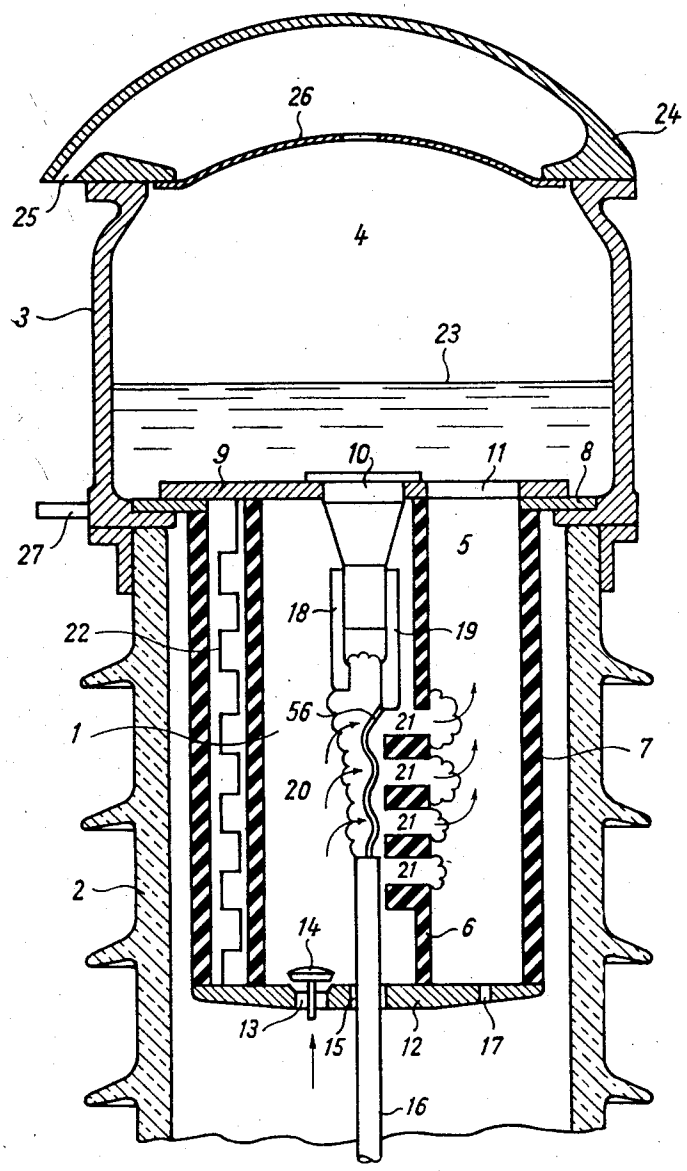


Fig. 1

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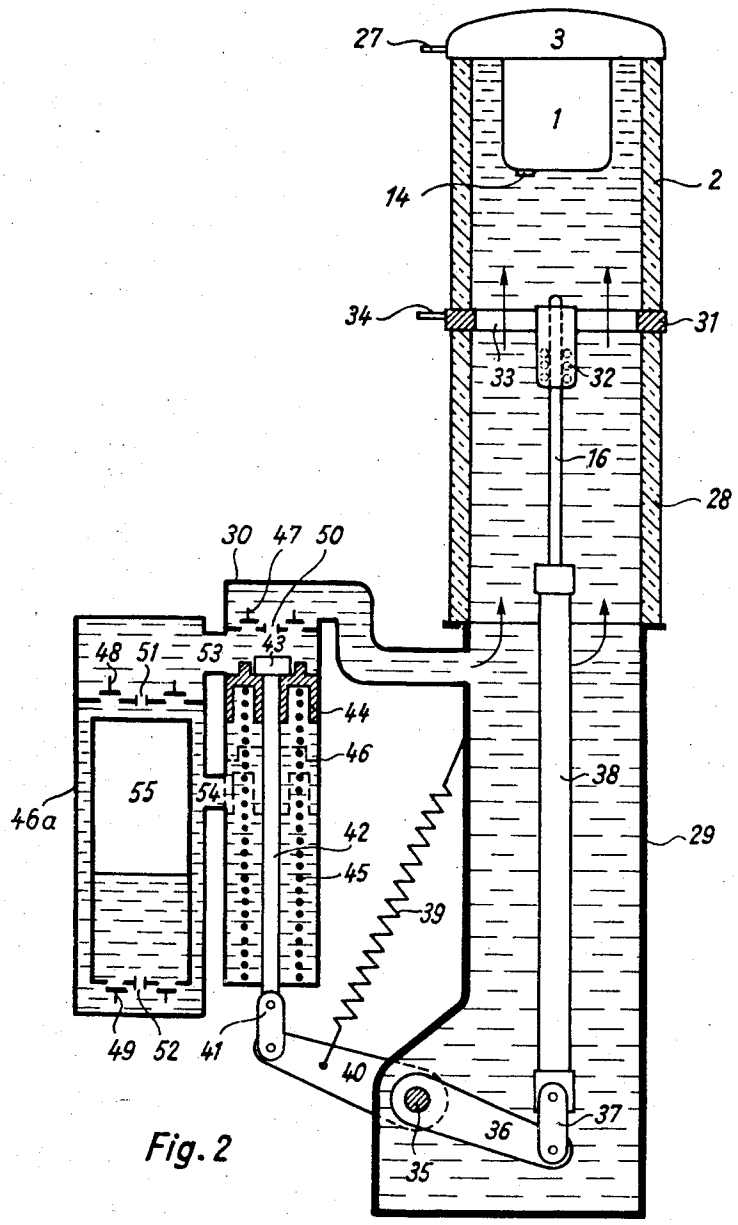


Fig. 2

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LOW-OIL CONTENT HIGH-TENSION OIL CIRCUIT BREAKER

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2 Claims. (Cl. 200—150)

This invention relates to a low oil content circuit-breaker of the kind in which oil is injected into the arc control chamber.

In circuit breakers of this type a known arrangement is to provide a pump inside the insulator for injecting oil into the arc control chamber through a tubular movable contact finger when the circuit is ruptured. However, this arrangement permits only a comparatively small amount of oil to be injected into the arc control chamber since the circuit breaker insulator offers insufficient space for anything but a small pump, the effect of which when the circuit is broken is correspondingly small.

In the present invention provision is made for the injection of a larger quantity of oil into the arc control chamber. To this end the invention provides an oil pump on the pedestal of the circuit breaker for the purpose of forcing oil through a hollow supporting insulator into the arc control chamber which is fitted with a non-return valve that permits oil to enter the arc control chamber only at pressures below a predetermined magnitude corresponding to the pressure engendered by the rupturing of a current of comparatively low value.

The size of the oil pump is therefore not determined by the available space on the inside of the circuit breaker but may be dimensioned to suit a delivery volume commensurate with what is required for the reliable suppression of the arc. Moreover, a pump so disposed offers the further advantage of being more accessible to inspection and easier to mount in position than a pump inside the circuit breaker.

The oil pump may be connected with an oil accumulator which fills the pump independently of the amount of oil available in the arc control chamber, with the resultant advantage that the pump retains its arc controlling effect even when the circuit is broken repeatedly in rapid succession, the pump always injecting an adequate supply of oil into the arc control chamber to extinguish the arc. This is a matter of especial importance in the case of circuit breakers which are used for short interruption, that is to say for breaking the circuit for short periods of time and then closing the circuit again, an action which may be repeated a number of times before the circuit is permanently ruptured should the cause of the fault persist.

In order to enable the invention to be more readily understood, reference is made to the accompanying drawings which illustrate diagrammatically and by way of example, one embodiment thereof and in which:

Fig. 1 is a longitudinal section of an arc control chamber; and

Fig. 2 is a longitudinal section on a smaller scale of one electrode of the circuit breaker and of the associated pump.

As shown in Fig. 1 an arc control chamber 1 is arranged inside the upper insulator 2, the top 3 of the circuit breaker being secured thereto. The arc control chamber is arranged for cross-jet arc control and forms an integral unit with the gas venting channel 5 which

discharges into the separator tank 4. The arc control chamber 1 consists essentially of two tubular members 6 and 7 made of a plastic and a glass fibre fabric. The inner cylinder 6 encloses the space in which arcing occurs, while the space between cylinders 6 and 7 serves as an adjacent venting channel 5. The outer tubular member 7 is suspended by means of a ring 8 from the top 3 of the circuit breaker and is covered with a plate 9 which carries a fixed contact 10 and is provided with an opening 11 for the gas venting channel 5. The bottom of the tubular member 7 is closed by a plate 12 provided with an opening 13 for a valve 14, an opening for the movable contact finger 16, and a return flow opening 17. The inner tubular member 6 contains the fixed contact 10 with the contact fingers 18 and an arcing piece 19. The tubular member 6 encloses the actual spark gap 20 which communicates through four transverse slots 21 with the gas venting channel 5 and through valve 14 with the cavity enclosed by the insulator 2. A resistor 22 disposed between the tubular members 6 and 7 connects plates 9 and 12 and thereby forms a bridge across the arc control chamber 1.

The upper part 3 of the circuit breaker is partly filled with oil 23 the space above the oil level serving as a separating chamber 4 for the collection of the oil. A cover 24 with a breather opening 25 and an oil baffle 26 forms the cap of the top part 3 of the circuit breaker. A connector 27 is electrically connected with contact 10 through ring 8 and plate 9.

Fig. 2 shows one of the electrodes in the open position, the arc control chamber 1, the insulator 2, and the top portion 3 thereof. 28 is a hollow supporting insulator through which an oil pump 30 arranged on the pedestal 29 can force oil into the arc control chamber 1. 31 is a flange with roller-type contacts 32 and openings 33. The roller contacts 32 establish the electric connection between the movable contact finger 16 and a stud connector 34. The movable contact finger 16 is operated through a shaft 35 by means of a lever 36, a shackle 37, and an insulating rod 38. For the purpose of its operation the contact finger is controlled by an interrupter spring 39 which acts on a lever 40. Through shackles 41 lever 40 operates a piston rod 42 with a head member 43, a slidable piston 44, and a spring 45 which together constitutes the oil pump 30. The latter also comprises a cylinder 46 which encloses the slidable piston 44. Adjacent to the pump cylinder 46, at a low part of the oil circulating system, is an accumulator consisting of inner and outer chambers 55 and 46*a*. The piston 44 has a fixed stroke extending from the forward position of the piston, shown in full lines, to the rearward position shown in dotted lines. The spring 45 constantly urges the piston 44 forwardly toward the end of the cylinder which communicates with the hollow insulator 28. In this end of the cylinder there are non-return valves 47 allowing oil flow from the pump to the insulator 28. When the contact 16 is moved upwardly to close the circuit at 18, 19, the enlargement 43 on the piston rod 42 pulls the piston rearwards to the dotted position against the urgence of the spring 45. When the contacts 16 and 18 are separated the piston is released for forward movement by the spring 45.

Between the pump cylinder 46 and the oil accumulator there are parallel communications 53 and 54 which establish a loop circuit through which the oil flows from the rear to the front of the piston 44 whenever the piston moves rearwardly. Non-return valves 48 are arranged in this loop.

At its lower end, the inner accumulator chamber 55 is provided with non-return valves 49 through which make-up oil is withdrawn when the piston moves forwardly.

Oil is pushed through valve **14** into the arc control chamber **1** whenever the pressure differential on the outside and inside of the chamber is of predetermined magnitude. This occurs when the ruptured current is relatively small. A stream of oil is always available under these circumstances to move transversely across the arc in the chamber **1** to extinguish it. The oil and gases generated move through the slots **21** into the gas venting channel **5**. The oil ultimately returns by gravity to the circulating system through the return flow opening **17**, thence back to the accumulator through return flow openings **50**, **51** and **52**.

When the circuit breaker is to be closed, an actuating device (not shown in the drawing) deflects levers **36**, **40** on shaft **35** in the counterclockwise direction until the movable contact finger **16** touches the fixed contact finger **18** (Fig. 1). In the closed position of the contacts both the interruptor spring **39** as well as the oil pump spring **45** will have been stressed or energised and the piston **44** will be in the rearward position indicated by the dotted lines. The downward movement of the piston **44** forces oil out of the space in the cylinder below the piston **44** through channel **54**, valves **48**, and channel **53**, back into the pump cylinder **46** above the piston **44**. During its downward travel the skirt of the piston **44** gradually closes channel **54** thus creating a smaller and smaller opening through which oil from below the piston **44** can still escape. Thus the piston during its rearward movement will serve as a damping element when the contacts are closed.

If the current when the contact fingers **16**, **19** separate (Fig. 1) is relatively small, then only a low energy arc **56** will be formed which will dissociate only a small volume of oil and cause a comparatively small flow through the slots **21** owing to the relatively limited increase of the pressure in the arc control chamber **1**. The oil pump **30** (Fig. 2) will therefore pump oil in the direction indicated by the arrows through the hollow supporting insulator **28**, the openings **33**, and the open non-return valve **13**, **14** (Fig. 1) into the spark gap **20** where the oil will cross the arc **56** and quench it, and then escape through the gas venting channel **5** into the separator chamber **4**.

Also, when the circuit breaker is opened, oil flows out of chamber **55** through the non-return valves **49** and through channel **54** into the space chamber below the pump piston **44**. If the circuit breaker remains inoperative after rupture, the oil forced by the pump into the arc control chamber **1** can gradually flow back from the separator chamber **4** into the accumulator **55**. To this end the lower cover plate **12** (Fig. 1) of the arc control chamber **1** is provided with the return flow opening **17** and further openings **50**, **51**, **52** are provided as previously described (Fig. 2).

If the circuit is reclosed and then interrupted a second time shortly after having been broken for the first time, then there will be no time for the oil to return to the accumulator **55**, so that the pump must again withdraw the required oil from the accumulator **55**. The capacity of the latter is therefore so determined that it will permit the circuit breaker to interrupt several times in succession, as is sometimes required of short time circuit breakers.

If, on the other hand, a heavy current, such as a short-circuit current, is interrupted, then the arc **56** forming between contacts **16** and **19** will dissociate sufficient oil for the gases thus evolved to generate a high pressure in the spark gap **20** (Fig. 1) and without the assistance of the pump **30** there will be created a powerful cross blast through the slots **21**, which will rupture the arc **56**. Owing to the high pressure generated in the spark gap **20** the non-return valve **14** will close and prevent the pump **30** from forcing oil into the arc control chamber **1** so that the piston **44** will remain stationary. Nevertheless the breaker movement will continue under the action of the interruptor spring **39**, because the piston rod **42** can slide in the stationary piston **44** and allow lever **40**, shaft **35**, lever **36**, shackles **37**, and insulating rod **38** to participate in the movement of the movable contact finger **16**.

What we claim is:

1. In a high-tension circuit breaker, a pair of relatively movable contacts adapted to be moved together to close a circuit and separated to break it, an arc control chamber enclosing a space in which arcing occurs, a hollow insulator supporting and enclosing said chamber and filled with oil which immerses said chamber, a wall of said chamber having a non-return valve to admit oil into the chamber when the pressure differential on the outside and inside of the chamber is of predetermined magnitude, an oil circulating system including a pump cylinder having one end in communication with said insulator, a piston movable forwardly toward said end and rearwardly away from it, a spring constantly urging the piston forwardly, a mechanism for moving said contacts, and means operated by said mechanism for moving and retaining said piston rearwards when the contacts are moved together and for releasing said piston when the contacts are separated, an oil accumulator in a low part of said circulating system, parallel communications between said accumulator and pump cylinder to establish a loop circuit in which the oil flows from the rear to the front of the piston whenever the piston moves rearwardly, and a non-return valve arranged in said loop, said accumulator comprising outer and inner chambers, the inner chamber having a non-return valve at its lower end from which oil is withdrawn when the piston moves forwardly.

2. A high-tension circuit breaker comprising a pair of relatively movable contacts adapted to be moved together to close a circuit and separated to break it, an arc control chamber enclosing the space in which arcing occurs and including a gas-venting channel alongside said space, a hollow insulator supporting and enclosing said arc control chamber and filled with oil which immerses said chamber, a wall of said arc control chamber having slots leading to said gas-venting channel and so located that an arc-quenching stream of oil moving transversely across an arc will pass through said slots into said venting channel, said chamber being also provided with an oil inlet in a wall thereof, an oil circulating system including a pump in communication with said hollow insulator and adapted to push oil through said inlet into said chamber, a non-return valve in said inlet adapted to open to admit oil only when the pressure within said chamber is below a predetermined magnitude, said venting channel having an opening through which oil may return by gravity into said insulator, said oil system including an oil accumulator located at a low part of said system, and means for feeding make-up oil from said accumulator to said pump whenever oil has entered said arc control chamber, whereby the oil supply to be acted upon by the pump is maintained irrespective of said return of oil from the venting channel.

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