

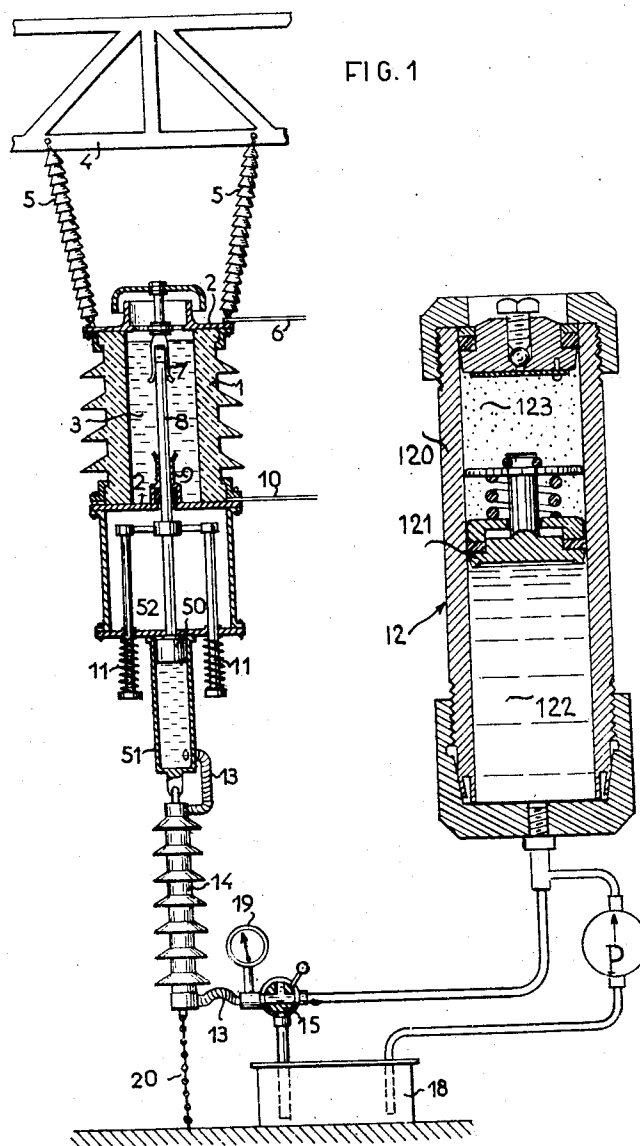
Aug. 18, 1959

J. L. GRATZMULLER
CIRCUIT-BREAKER CONTROL DEVICE

2,900,469

Filed Dec. 27, 1954

2 Sheets-Sheet 1



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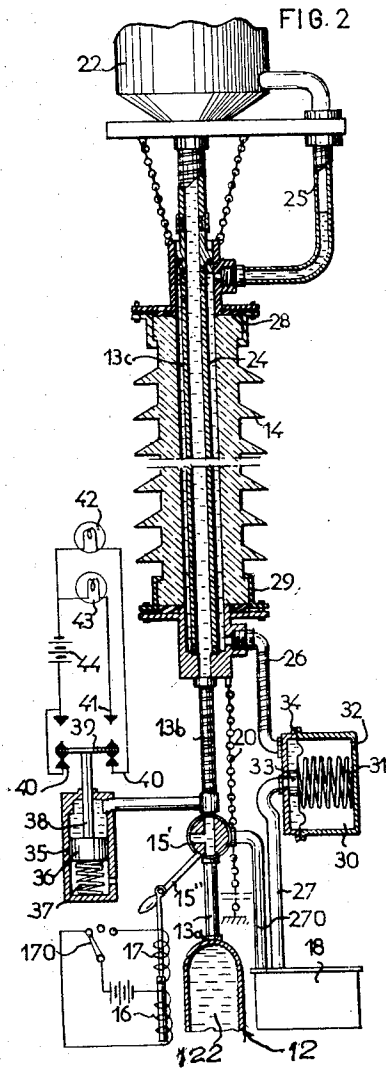
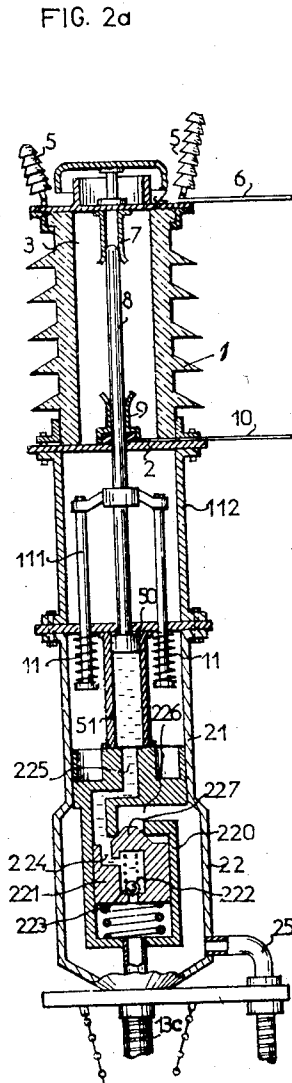
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CIRCUIT-BREAKER CONTROL DEVICE

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4 Claims. (Cl. 200—82)

In most of the circuit-breakers or other electric switching devices, at least a part of the switching mechanism is at high potential, at least normally i.e. when the circuit-breaker is in contact-making position and fed with current. Now, the control of circuit-breakers is usually effected from the ground, or more generally at a remote control station by a control arrangement at ground potential.

In these conditions, the said control requires:

(1) That the mechanical connection between such control station and the part of the mechanism which is at ground potential be ensured exclusively through insulating means.

(2) A power circuit or transmission from the ground to the part of the mechanism at high potential, to actuate the circuit-breaker.

(3) The possibility of continuously supervising at the control station the operation of the circuit breaker.

Moreover, generally speaking, the operation of a circuit-breaker further requires:

(1) a rapid and safe contact break,

(2) a safe and sure holding of the movable contact member in both contact-making and contact-breaking positions.

Finally, it is advantageous to reduce to a minimum the number of connecting elements between the parts at high potential and the parts at ground potential.

The invention has for its purpose to provide a circuit-breaker control device fulfilling all these requirements while being far more simple and, hence, far cheaper than all the existing control devices.

The circuit-breaker control device according to the invention essentially comprises a part at ground potential, a part directly associated with the mechanism to be controlled, and hence, at the same high potential as the said mechanism and an insulating connection between both said parts.

An object of the invention is to provide a control device of this type, wherein the part at high potential is constituted by a single acting hydraulic jack adapted to be operated by an insulating liquid such as oil against elastic means capable of returning the jack piston to its original position, as the liquid contained in said jack is evacuated, wherein the part at ground potential comprises a source capable of feeding the said jack with the said insulating liquid at a suitable pressure and means for controlling feeding of the jack and evacuation of liquid therefrom and wherein the connection between both parts is essentially constituted by a duct made of an insulating material as well as by the column of insulating liquid contained in the said duct.

A further object of the invention is therefore to complete the control device by a manometric instrument adapted to detect the pressure in the part at ground potential of the feeding duct. As soon as the said pressure is higher than the pressure required for completing the whole active stroke of the jack piston against the action of the elastic means or, on the contrary, lower than the

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pressure for which the liquid contained in the jack can be completely evacuated under the action of the said elastic means, such a manometric instrument indicates that the said piston is at the very end of either its circuit-making or its circuit-breaking strokes, respectively.

It is a further object of the invention to provide a suspended circuit-breaker which includes stationary and movable circuit making and breaking members, operable in one position to establish circuit making relation and in another position to break the circuit, permanently available force applying means operably connected to the movable member to move the same in one direction, a source of liquid under a constantly available predetermined pressure valve controlled conduit means governing the flow of said liquid and in which the circuit breaker includes a single acting hydraulic jack actuated in one direction only by said liquid and with the movable member of the jack operably connected to the movable circuit making and breaking member, and in which means are provided for rapidly evacuating the jack under valve control substantially in accordance with the teaching of my prior filed U.S. application Serial No. 474,538 filed December 10, 1954, and titled "Remotely Controlled Evacuation Device for Hydraulic Jack."

It is a specific object to provide a circuit breaker of the type set forth in the immediately foregoing paragraph with the afore-referred to insulating conduit means incorporated between the substantially permanently available source of liquid under pressure and the jack and in which the liquid is fed to the jack in a completely insulated path and when the jack is discharged under valve control the fluid being discharged constitutes a portion of the insulation.

Other objects and advantages of the invention will be apparent from the following detailed description, together with the accompanying drawings, submitted for purposes of illustration only and not intended to define the scope of the invention.

In these drawings:

Figure 1 is a diagrammatic view of a suspended circuit-breaker provided with a control device according to the invention including an oleo-pneumatic accumulator which for purposes of clarity is illustrated on a greatly enlarged scale.

Figures 2 and 2a together illustrate a modification showing a single insulating connection ensuring both feeding of the jack and return of liquid to the container, the respective figures are partly in elevation and partly in longitudinal section, with Figure 2 illustrating the bottom half of the arrangement and Figure 2a the top half.

The suspended circuit-breaker diagrammatically shown in Figure 1 comprises a body 1 made of an insulating material such as porcelain and terminated at both ends by two tightly closing members 2, the said body containing the circuit-breaking chamber 3. The body 1 is suspended, for example on a suitable bracket 4, through insulators 5, the length of which is calculated as a function of the voltage of the current to be cut-off.

One of the conductor lengths to be separated, 6, is connected to a fixed contact 7, e.g. tulip-shaped, engageable by a movable contact 8 slidably mounted in a sleeve 9 to which is connected the other one 10, of the conductor lengths to be separated.

The conducting rod constituting the movable contact 8 is solid with the piston 50 of a hydraulic jack 51 having for its function to bring the movable contact 8 into contact-making engagement with the fixed contact 7, against the action of elastic means, such as the springs 11, capable of ensuring circuit-breaking by returning the rod 8 into such a position and at such a speed as to safely ensure contact-breaking. With this arrangement, the part

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of the mechanism comprising the jack 51, its piston 50, its springs 11, and the movable contact 8 is always at the same voltage as the conductor length 10. The inner insulation of the circuit-breaker between the poles 7 and 9, when the contacts are separated, is ensured in the usual manner e.g. by oil contained in the circuit-breaking chamber 3.

According to the invention, the jack 51 fed from a source of insulating liquid such as oil, under pressure, the said source being constituted, in the example shown by an oleo-pneumatic accumulator 12, through an insulating duct 13 which is preferably flexible at least along a portion of its length, the said duct being further provided with usual outer insulating means such as a porcelain insulator 14. As described in my prior Patents No. 2,724,412 dated November 22, 1955, and entitled "Hydro-pneumatic Accumulator," and No. 2,746,486 dated May 22, 1956, and entitled, "Fluid Tight Assembly," the oleo-pneumatic accumulator 12 includes a casing 120 having a movable partition or piston member 121 dividing the interior of the casing into a liquid containing compartment 122 and a compressed gas containing compartment 123. The accumulator is charged with liquid and pressurized gas to such an extent that the partition or piston exerts a force on the liquid in the liquid compartment sufficient to place that liquid under a constantly available pressure that is far in excess of the force of spring force-applying means 11.

The feeding of the jack 51 is controlled in the diagrammatic scheme of Figure 1 by a simple three-way cock 15 actuated e.g. by a contact-making electro-magnet 16 and a contact-breaking electro-magnet 17 (see Figure 2). In the position shown in Figure 1 of the three-way cock 15, it may be seen that a pressure fluid is sent into and maintained in a jack 51, so that the movable contact 8 of the circuit-breaker 1 is held in the contact-making position shown, in which the two conductor lengths 6 and 10 are interconnected. An abutment 52 locates the piston 50 and, hence, the movable contact 8 in a correct position ensuring a good electric contact.

The contact-breaking electro-magnet 17, when energised, causes evacuation of the liquid from the jack 51 through the insulating duct 13 e.g. by setting the same into communication with the liquid container 18 upon a suitable actuation of the three-way cock 15. It is to be understood that the above description is given as a mere illustration while, in practice, the control of the feeding and unloading of the jack may be made in any suitable manner within the scope of the invention.

I have diagrammatically shown at 19, under the form of a simple manometer, a device responsive to the pressure in the duct 13 and consequently in the jack 51.

Such a pressure-responsive device permits, according to another feature of the invention and as already mentioned above, knowing at any time the position of the circuit-breaker.

In practice, such a device will be preferably provided with displaying means such as signal lamps, so as to permit directly supervising the operation of the circuit-breaker (see Figure 2).

There is shown at 20 a chain for anchoring the suspended circuit-breaker, the said chain being secured at the lower end of the insulator 14 of the duct 13.

In the embodiment of the invention shown in Figures 2 and 2a the component parts that are the same as in the Figure 1 arrangement bear the same reference characters. Thus, in this form of the invention there is disclosed a circuit-interrupting device which, like in the Figure 1 arrangement, is a suspended device, and incorporates a porcelain body 1 closed at each end by closure members 2 so that the interior of the body defines a circuit-breaking chamber 3. The body 1 is suspended by suitable insulators 5. Within the body is a stationary contact 7, a movable contact 8 that is slidably mounted in a sleeve 9 and which is fast with the rod of piston 50. The respec-

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tive conductors are denoted at 6 and 10 and these are, respectively, in circuit with the fixed contact 7 and the sleeve 9. Spring force applying means 11 are operatively associated with the movable contact 8 in that they surround rod members 111 carried by a bracket fast with the rod of piston 50. These rods 111 are disposed through holes in a casing 112 and the spring force applying means 11 are biased between the bottom of the casing and heads on the ends of rods 111. Thus the spring force applying means constantly urge the movable contact toward circuit-breaking position. Depending beneath the casing 112 is a hydraulic jack 51 constituting cylinder and piston means, one of which is movable relative to the other. In this case the piston 50 is movable relative to the cylinder of the jack 51. As stated previously, the movable contact 8, being fast with the rod of piston 50, is thus permanently and kinematically connected to the movable one of the cylinder and piston means so that for every position of the piston 50 there corresponds a precise position of the movable contact. An oleo-pneumatic accumulator 12, similar to the Figure 1 arrangement, is provided to furnish liquid under pressure for actuating the movable contact to circuit-making position. The system further includes a tank 18 and conduit means including a first portion 13a in communication with the liquid compartment of the accumulator and leading to manually actuated control valve means 15', a second portion 13b that is flexible and communicates with a further conduit portion 13c surrounded by an annular insulation member 14 that provides an annular space or duct 24 about conduit portion 13c. The conduit portion 13c is extended to enter a container or canister 22 within which is disposed means for rapidly discharging liquid from the jack in response to suitable actuation of the control valve means 15'. Thus, as described in my prior filed application Serial No. 474,538, filed December 10, 1954, and entitled "Remotely Controlled Evacuation Device for Hydraulic Jack," the liquid from the liquid compartment of the accumulator flows through the conduit means with the control valve in the position shown in Figure 2 and enters a valve casing 220, Figure 2a.

Within the casing is a movable piston type valve member 221 having a central bore 222 within which is a non-return ball valve 223. A passage 224 provides communication between the central bore 222 and a further passage 225 leading to the lower end of the cylinder of the jack 51. The end of the partition or piston 221 remote from the outlet end of conduit portion 13c is shaped to define a valve member that cooperates with a seat on a discharge duct 226. Therefore, when fluid under pressure enters casing 220, it unseats the ball valve 223, applies the valve head 227 to close discharge duct 226, flows through duct 225 into the jack to raise the piston 50 and thus move the movable contact 8 to circuit-making position. Since the fluid is locked in the cylinder the means for maintaining the circuit constitutes the pressure of the liquid within the cylinder. From the lower end of the tank or canister 22 there extends a conduit portion 25, see Figure 2, that is in communication with the annular space or conduit 24 between the insulator 14 and conduit portion 13c. From the lower end of this annular space there extends another conduit or pipe portion 26 that communicates with a valve chamber 30. From the valve chamber 30 there extends a return duct 27 that communicates with the tank 18.

The system, see Figure 2, further includes a return pipe 270 providing return flow communication between the control valve means 15' and tank 18. Closure and packing means 28 and 29 are provided at opposite ends of insulation member 14 to insure the fluid tightness of the annular passage or duct portion 24.

The manually actuated control valve means includes a contact making electromagnet 16 and a contact breaking electromagnet 17 operably coupled with the lever 15' of the control valve 15'. A suitable manually actuated

switch 170 effects energization of the electromagnets 16 and 17 in a desired manner so that in the position shown in the drawing contact making electromagnet 16 has drawn the lever 15' to a position to move the valve means to establish communication between the liquid compartment of the accumulator and the cylinder of the jack so as to effect movement of the movable contact into circuit-making position. Since the dumping valve means within the tank 22 is also a part of the conduit means, the contact is permanently maintained in circuit-making position solely by the pressure of the liquid in the cylinder. When the valve means 15' are actuated in another position as a result of movement of switch 170, communication is established between the cylinder and the tank via the dumping valve and also by the reverse flow through conduit portions 13c, 13b and 270. When the pressure beneath movable partition or piston 221 in the dumping valve mechanism is lowered by the reverse flow through conduit 270 to tank 18, the spring force applying means 11 drives the piston 51 downwards in its cylinder so that the movable member or partition 221 moves down to open discharge duct 226. As disclosed in said prior filed application Serial No. 474,538, the cross-sectional area of the discharge duct 226 is larger than that of the inflow duct 225 so that liquid rapidly flows into tank 22 and thence out into the conduit portion 25 through the annular duct 24 past the valve 33 and into the tank 18. It is therefore clear that the invention provides liquid dumping means operatively associated with and adjacent the cylinder of the jack and in communication with the tank and operable when the valve means 15' is in the position determined by electromagnet 17 to rapidly evacuate liquid from the cylinder and to discharge liquid to the tank.

It is further to be noted that in the hydraulic jack 51 the inflow conduit means 13a, 13b, 13c, and a substantial portion of the outflow conduit means including the annular duct 24, are disposed in more or less in line relation, with the annular duct 24 being coaxial with and surrounding a substantial portion of the length of the conduit means 13c.

It has been explained hereinabove that the insulating connection between the part of the mechanism at high potential and the control station at ground potential is ensured by the column of pressure liquid contained in the duct 13 as well as the said duct itself and its outer insulation. For the return pipe, it is preferred, for ensuring the presence in the annular passage 24 of an insulating liquid column of a level corresponding at least to the insulating length required by the voltage of the current to be cut off, to interpose e.g. between the pipe length 26 and the return duct 27 a valve provided with a diaphragm 34 acted upon by a return spring 31. Said valve has one chamber 30 communicating with atmosphere at 32, while its other chamber communicates, on the one hand, freely with the pipe length 26 and, hence, with the annular passage 24 and, on the other hand, under the control of a valve closing member 33 solid with a diaphragm 34, with the duct 27 leading to the container 18.

In these conditions, it will be understood that, as soon as the pressure in the pipe length 26 becomes lower than a predetermined value corresponding to a certain level of the fluid in the annular passage 24, the diaphragm 34 yields under the action of the spring 31 and seats the closing member 33 of the valve thus interrupting flow of liquid towards the container.

In the showing in Figure 2, the above mentioned means responsive to the pressure in the duct 13 and provided to give an indication of the circuit breaker position, include a jack 35, the piston 36 of which is subjected on one side to the action of a calibrated spring 37 and on the other side to the pressure in the duct 13. The rod 38 of the piston 36 carries a contact 39 switchable between two pairs of fixed contacts 40, 41 respectively incorporated in the feeding circuits of two signal lamps 42-43 fed

with electric current from any suitable source such as the battery 44. This device is so adjusted that the movable contact 39 completes the circuit of the lamp 42 when the pressure in the duct 13 is higher than the value required for ensuring the complete contact-making stroke of the jack piston 50, while it establishes the circuit of the lamp 43 when the said pressure is lower than the value for which the springs 11 are capable of ensuring the whole circuit-breaking stroke of the said jack piston.

While the invention has been described with particular reference to a preferred embodiment, it is not intended to limit the scope of the invention to the embodiment illustrated, nor otherwise than the terms of the subjoined claims.

In particular, the invention may be applied to circuit-makers and more generally to any switching device, in particular for high-voltage current.

What is claimed is:

1. A circuit-interrupting device including a stationary contact, a movable contact, spring force applying means operably connected to said movable contact to constantly urge the same toward circuit-breaking position, cylinder and piston means one of which is movable relative to the other, means permanently and kinematically connecting the movable one of said cylinder and piston means to said movable contact so that for every position of said movable one of said means corresponds a precise position of said movable contact, an oleo-pneumatic accumulator including a casing, a movable partition within the casing and dividing the interior thereof into a liquid containing compartment and a compressed gas containing compartment, liquid in the liquid containing compartment under a constantly available pressure far in excess of the force of said spring force-applying means, a tank, conduit means between the liquid compartment of the accumulator and the cylinder, and between said cylinder and said tank, manually actuated valve means operably associated in said conduit means and operable in one position to establish communication between said cylinder and liquid compartment and block communication between said cylinder and tank so as to effect movement of said movable contact into circuit making position and to permanently maintain said circuit solely by the pressure of liquid in the cylinder, said valve means being operable in another position to establish communication between said cylinder and tank and block communication between said compartment and said cylinder, whereby said spring force applying means can effect movement of said movable contact to circuit-breaking position, and liquid dumping means operably associated with and adjacent said cylinder and in communication with said tank and operable when said valve means is in said another position to effect rapid evacuation of liquid from said cylinder and to discharge liquid to said tank.

2. A circuit-interrupting device as claimed in claim 1, and further including liquid pressure responsive signaling means operably associated with the conduit means between said manually actuated valve means and the cylinder for indicating the position of said movable contact, said pressure responsive signal means including a conduit in communication with said conduit means between said cylinder and said manually actuated valve means.

3. In a circuit-interrupting device as claimed in claim 1, and said conduit means between the liquid compartment of the accumulator and the cylinder including a portion disposed in substantial alignment with said cylinder, an insulator surrounding a substantial part of said portion of said conduit means and in spaced relation thereto, the conduit means providing communication between the cylinder and the tank including the space between the insulator and the said portion of the first-mentioned conduit means.

4. In a circuit-interrupting device as claimed in claim 1, and the conduit means between the cylinder and the tank

including an annular duct surrounding a portion of the conduit means that extends between the liquid compartment of the accumulator and the cylinder, a conduit portion providing communication between the liquid dumping means and one end of the annular duct, further conduit means providing communication between the other end of the annular duct and said tank, and valve means operably associated with said further conduit means and operable to maintain an insulating liquid column within said annular duct, said valve means being operable in response to pressure of liquid within the additional conduit means between said other end of the annular duct and said valve means to control the level of the liquid in the insulating column in response to pressure of liquid so as to block communication between said valve means and the tank whenever the liquid level within the insulating column falls below a predetermined level.

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