United States Patent

[11] 3,604,871

[72] Inventor **Karl Kriechbaum**
Kassel, Germany

[21] Appl. No. **12,172**
[22] Filed **Feb. 18, 1970**
[45] Patented **Sept. 14, 1971**

[73] Assignee **Licentia Patent-Verwaltungs-GmbH**
Frankfurt, Germany

[32] Priority **Apr. 5, 1969**
[33] **Germany**
[31] **P 19 17 724.3**

[54] **GAS BLAST CIRCUIT-INTERRUPTING DEVICE HAVING QUICK-ACTING CONTACT RELEASE MEANS**
13 Claims, 2 Drawing Figs.

[52] **U.S. Cl.** **200/148**
[51] **Int. Cl.** **H01h 33/00**
[50] **Field of Search** 200/148

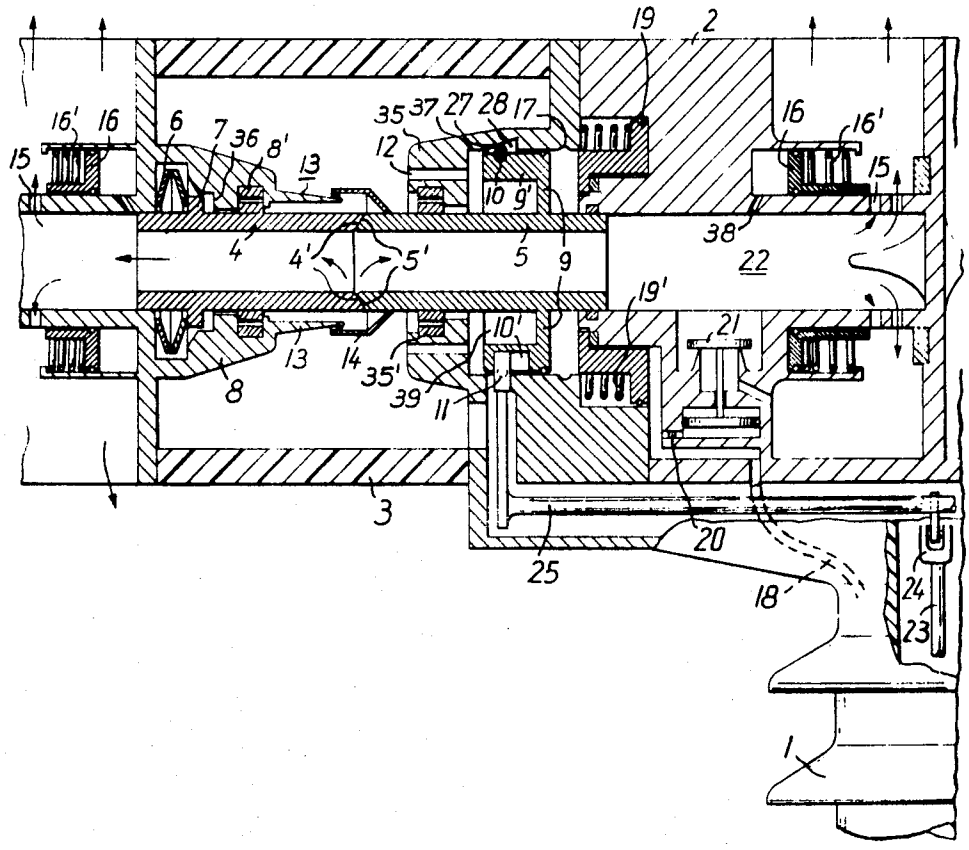
[56] **References Cited**

UNITED STATES PATENTS

3,002,073	9/1961	Cobine	200/148
3,095,488	6/1963	Eidinger	200/148
3,213,334	10/1965	Forwald	200/148 B
3,244,844	4/1966	Forwald	200/148 B

Primary Examiner—Robert S. Macon
Attorney—Spencer & Kaye

ABSTRACT: A circuit-interrupting device having extremely short switch-off times with a pressure chamber designed to contain a quenching gas under pressure and a pair of oppositely opposed contacts guided for a limited movement within the pressure chamber. A spring biases one of the contacts toward the other; and a quick-acting release device, such as a piston ring lock, holds the other contact against the first contact under high contact pressure when the interrupting device is in its switch-on position. The contact that is retained by the release device is biased only by the quenching gas in the switch-off direction. When the release device releases this contact, the two contacts separate from each other very rapidly. The contacts are sealed so that the quenching gas can not escape through the hollow bore of the contacts until they have separated. The release device may be provided with a suitable device to compensate for temperature fluctuations. The actuation of the release device may occur in dependence on the net current in the circuit, so that the separation of the tubular contacts occurs under minimum arc duration and, thus, with minimum switching effort.



PATENTED SEP 1 4 1971

3,604,871

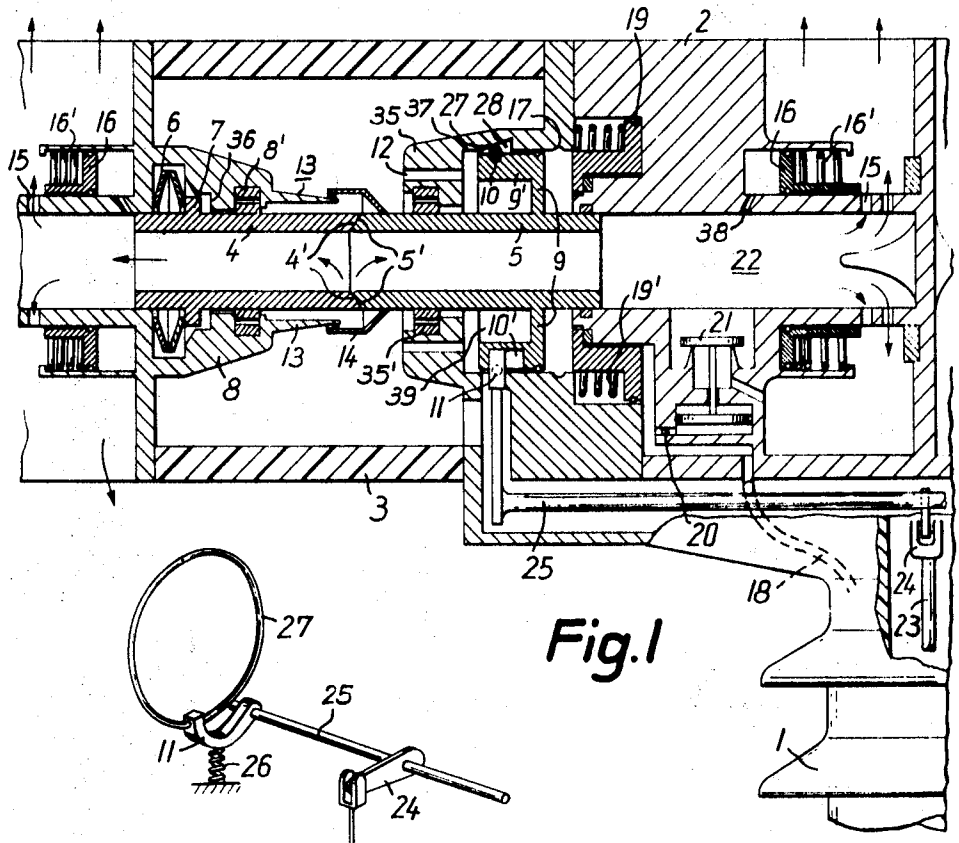


Fig. 1

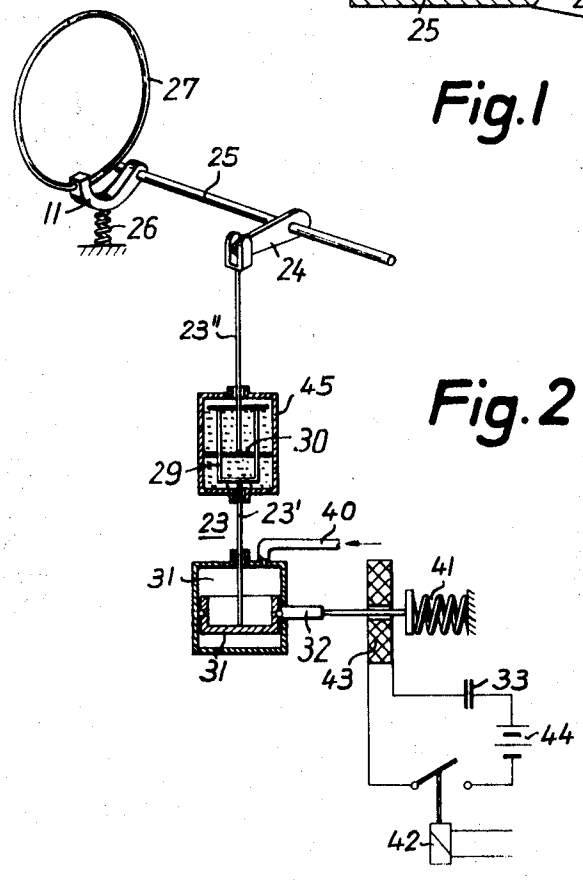


Fig. 2

Inventor:
Karl Kriechbaum

BY *Spencer & Kaye*
ATTORNEYS.

GAS BLAST CIRCUIT-INTERRUPTING DEVICE HAVING QUICK-ACTING CONTACT RELEASE MEANS

BACKGROUND OF THE INVENTION

The present invention relates to a circuit-interrupting device having extremely short switch-off times, in which two hollow contact elements are disposed under high contact pressure within a chamber filled with a gaseous-quenching medium. Such pressure chamber breakers, which interrupt a short-circuit current within one or two half-waves, are known in which the movable, hollow contact elements are separated by electrodynamic forces; the flow of pressurized air into the switching path taking over the further movement of the contact elements into their end positions, as well as the quenching of the arc. However, electrodynamic actuators disposed at high-voltage potential require high technical expenditures, since the actuation instruction must be brought from ground potential to high-voltage potential, and the capacitor which initiates the charging of the actuating jolt, and which is at high-voltage potential, must receive its charging current by way of transformers which are insulated against high voltages.

Another more simply constructed pressure chamber circuit breaker provides a rapid actuation in such a manner that the air is removed from an annular chamber provided directly at the switching path, so that the air pressing from the outside onto a diaphragm reaches the rear of a drive piston for the movable hollow contact element and, thus, effects separation of the contact elements. But a very high switching speed can not be achieved in this manner, since the removal of air and the subsequent influx of air requires a longer period of time because of the inertia of the flowing air. Further, the drive must also operate against the air pressure at hand.

SUMMARY OF THE INVENTION

The present invention, therefore, proceeds in a different manner in order to arrive at a simply constructed pressure chamber circuit interrupting device having extremely short switch-off times, i.e. an interruption of the short-circuit current within one or two half-waves. According to the present invention, one hollow contact element is constructed in a known manner to be a follower contact under high pressure and the other movable contact element, which is only under the pressure of the quenching medium effective in the switch-off direction, is held in the switched-on position by an extremely rapidly actuatable arresting device. This embodiment of the breaker makes it possible, on the one hand, to apply high contact pressure and, on the other hand, to achieve high acceleration of the hollow contact elements in the switch-off direction after the arresting device has been triggered, since no counterforces act against the switch-off movement. Moreover, the arresting device, when it is actuated electrodynamically, can be triggered within a few milliseconds. Such an arresting device advantageously consists of a piston ring disposed in an annular groove of the drive piston of the movable hollow contact element, which piston ring is resilient in the plane perpendicular to the axis of movement of the contact element, and of a ring-shaped groove arranged in the drive cylinder to correspond to the switched-on position. The piston ring engages the groove in the drive cylinder in the switched-on position by being spread by means of an externally actuated locking member. Such arresting devices per se are known.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a cross-sectional, elevational view of one-half of the double-switching chamber of a circuit breaker according to the present invention in which the contact elements are in the switch-on position.

FIG. 2 shows schematically the drive for the actuation of the arresting device.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 shows a switching chamber 2 resting on a suitable support member 1. The switching path of the switching chamber 2 is in a glass fiber-reinforced pressure chamber 3 which contains a suitable quenching fluid, such as a gas under pressure. The construction of such chambers is well known in the art. As can be easily seen the switching chamber 2 is only part of a double system. The other omitted switching chamber is similar or has the equal dimensions and contains the equal parts. It is clear that both switching chambers 2 are simultaneously operated in the same way.

A pair of guide elements 8 and 35 are arranged in the interior of the pressure chamber 3, so as to guide a pair of movable, tubular contacts 4 and 5. Annular contacts 8' and 35' are arranged between the guides 8 and 35 and the contacts 4 and 5, respectively, so as to transfer the current from the solid parts to the movable contacts 4 and 5. A strong cup, or annular, spring 6 is arranged between an inner wall of pressure chamber 3 and an annular abutment 7 on contact 4, so as to bias contact 4 toward contact 5. Guide 8 is so designed that the surface of abutment 7 opposite to that surface-engaging spring 6 will engage surface 36 of guide 8 after contact 4 has moved a predetermined distance in the direction of contact 5, and thus limit its movement. When one end surface of each of contacts 4 and 5 abut each other, the breaker is in its closed, or switched-on position. In this position, both contacts are under a predetermined high contact pressure. Contact 5 is provided with an annular drive piston 9 which moves within an open space 39 provided in guide 35. Channels 12 are provided in guide 35 to permit a flow of pressurized quenching gas into the space 39 so as to exert a pressure on piston 9 in the direction away from contact 4. Piston 9 has a rim portion 9' having an annular recess, or groove, 10 around its outer circumference. Piston ring 27 fits into groove 10, and also fits into a flattened groove 28 in the wall 37 of guide 35. Wall 37 forms the cylinder for piston 9. A locking member 11, which is preferably a flat lever element (see FIG. 2) locks the piston and hence indirectly contact 5 against contact 4, and also against the pressure of spring 6 and the quenching gas, by expanding piston ring 27 so that it is simultaneously seated in grooves 10 and 28. A recess 10' is provided in a section of the outer periphery of flange 9' to enable locking member 11 to fit between the opening in piston ring 27.

In order for the pressurized air to be unable to flow out of the pressure chamber 3 between the mating surfaces 4', 5' when the switch is closed, the juncture is sealed by means of a two-piece tubular device 13 which separates in the open contact, or switched-off, position. Only when a switch-off takes place does the portion 14 of device 13 slide away from portion 13' and open a path for the pressured quenching gas to flow out through the contacts in the two directions indicated by the arrows. This flow extinguishes the arc. At each end of the chamber 3 there are disposed flowout openings 15, through which the quenching gases can flow out into the atmosphere. These flowout openings 15 are closed after a certain predetermined interval of time by the pressurized gas which passes opening 38 and acts on gate valve 16 against spring 16' so that the contacts 4 and 5 are held open in the switch-off position by the available pressure in chamber 3. Thus, a special separating switch is not required. In the guide member 35 for the contact 5, there is disposed an overflow channel 17 through which the pressurized gas can flow to the rear of the piston 9 after a certain stroke of the piston 9, so as to dampen the switch-off movement.

For the switching-on process, air is fed to a drive piston 19 through a special pressurized-air channel 18, causing piston 19 to move against spring 19' and rest against piston 9 after a certain stroke. This will bring contact 5 back into the closed position against the pressure of spring 6 and the available quenching medium. In the closed position, the locking member 11, which is under the pressure of a spring 26 (FIG.

2) again snaps into recess 10 of piston 9 and locks both contacts 4 and 5 in this position. During the switch-on process, pressurized air from channel 18 is simultaneously sent through a choke element 20 to a ventilating valve 21, so that it ventilates the flowout channel 22. After completed ventilation, the gate valve 16 reopens. Choke 20 may be any suitable, well-known type.

The actuation of the arresting device occurs through an insulating rod 23 which engages a crank 24 (see FIGS. 1 and 2). The crank 24 itself is rigidly connected with a crankshaft 25. Locking members 11 are fastened to the ends of this crankshaft. As described above, these locking members, under the bias of spring 26 (FIG. 2) move between resilient piston ring 27 and, thus, spread the ring apart. The piston ring 27 engages groove 10 in the drive piston 9 as well as groove 28 in wall portion 37 of guide member 35.

This produces a rigid lock which can not be released even by the combined pressure of the spring 6 and the available quenching medium. Only when rod 23 moves downward, and shaft 25 performs a corresponding rotational movement, does piston 9 become released from its guide 35. This causes a high acceleration force to be released, which moves the contacts 4 and 5 into the open position within a few milliseconds.

It will thus be seen that, in accordance with the present invention the release device through member 11 blocks the movement of the contact 5 away from biased contact 4, in consequence of which contacts 4 and 5 are held in engagement with each other, when the member 11 blocks the movement of contact 5, by the force exerted by the spring 6 and, when said member 11 is actuated and unblocks contact 5, contact 5 moves away from contact 4 under the influence of the pressure of the quenching fluid on piston 9, with contact 4 being prevented from following contact 5 by abutment 7 engaging face member 36.

According to FIG. 2, a hydraulic compensating device 40 may also be included in the path of the insulating rod 23. This device makes it possible to compensate for changes in the length of this rod due to temperature fluctuations. The lower portion 23′ of the rod 23 hangs from a piston element 29 and the upper rod portion 23″ is attached to a piston element 30. The pistons 29 and 30 are housed in a liquid-filled container 45 and mesh together so that they form three compartments in fluid communication with each other. When the insulating rod performs small, slow movements, there might occur an exchange of liquid between the two intermeshed piston elements without changing the position of the locking member 11. When rod 23 performs a switch-off movement, however, the liquid cannot be compensated quickly enough below and above elements 29 and 30, so that this movement is completely transferred to the locking member 11 as desired. Rod 23 is continuously under the pressure of high-pressure air entering housing 31′ through conduit 40. As a result, the lower end of rod 23′ is attached to a drive piston 31 which is also held in the normal, or closed, position by a piston ring lock 32, biased into the locked position by spring 41. The locking member 32 in this case is actuated electrodynamically, in a known manner, by means of closing a solenoid-and-plunger switch 42 and sending an impulse from a conventional power source 44 discharging through a suitable, known capacitor 33 to a suitable solenoid device 43. The actuation of piston 31 may occur in dependence on the steepness of the net current, so that the separation of the contacts occurs under minimum arc duration and, thus, with minimum switching effort. In this manner, the breaker can act as a synchronous switch.

It will be understood that the above description of the present invention is susceptible to various modifications, changes and adaptations and the same are intended to be comprehended within the meaning and range of equivalents of the appended claims.

1. A circuit-interrupting device having extremely short switch-off times comprising, in combination:

a. means forming an arc-quenching chamber adapted to contain an arc-quenching fluid under pressure;

b. first and second contact means arranged in said chamber for movement into and out of engagement with each other;

c. means for biasing said first contact means in the direction toward said second contact means;

d. means for limiting the travel of said first contact means in the direction toward said second contact means;

e. means responsive to the pressure of the arc-quenching fluid in said chamber for exerting on said second contact means a force for moving said second contact means away from said first-contact means; and

f. quick-acting release means for blocking the movement of said second contact means away from said first contact means under the influence of said means (e), in consequence of which said first and second contact means are held in engagement with each other, when said release means blocks the movement of said second means, by the force exerted by said biasing means and, when said release means are actuated and unblock said second contact means, the latter are moved away from said first-contact means under the influence of said means (e) with said first-contact means being prevented from following said second contact means by said means (d).

2. A circuit-interrupting device as defined in claim 1 further including guide means defining a cylinder having flattened recess and arranged about said second-contact means and wherein said pressure-responsive means is a piston means with an annular recess and is arranged within said guide means, and said release means includes a piston ring arranged in said annular recess and means to spread out said piston ring so that it will simultaneously engage said annular recess in said piston and said flattened recess in said guide means to lock said second contact means in the switch-on position.

3. A circuit-interrupting device as defined in claim 2 wherein said release means further includes a crankshaft and means to rotate said crankshaft, and wherein said means to spread apart said piston ring is a flat lever element mounted on said crankshaft.

4. A circuit-interrupting device as defined in claim 3 wherein said means for rotating said crankshaft is an electrodynamic trigger actuated in dependence on the steepness of the net current such that the separation of said first and second-contact means occurs with a minimum duration of the arc and minimum switching effort.

5. A circuit-interrupting device as defined in claim 4 herein said actuating means further includes hydraulic-compensating means having a pair of intermeshing piston elements each mounted on a respective rod element and a fluid bath in which the piston elements are arranged so that changes in the overall length of the rod elements during temperature fluctuations are compensated.

6. A circuit-interrupting device as defined in claim 3, further including a pneumatically actuated piston means, separate from said piston means on said second-contact means and independent of said second-contact means, and arranged so as to engage said second-contact means and move it toward said first-contact means to switch on the device.

7. A circuit-interrupting device as defined in claim 6, wherein said contact means have passages that open to the quenching fluid when said contact means move away from each other, and further including exhaust means for the quenching fluid having at least one opening for each of said contact means, and valve means actuated by the quenching fluid to close said exhaust means after a predetermined time delay.

8. A circuit-interrupting device as defined in claim 7, further including ventilating valve means arranged adjacent to at least one of said exhaust means so as to permit ventilation of said valve means for said exhaust means after a predetermined time delay during the switching-on of the device.

9. A circuit-interrupting device as defined in claim 8, further including an overflow channel means disposed in said guide means so that the quenching fluid can pass around said

piston means on said second contact means to dampen the movement thereof.

10. A circuit-interrupting device as defined in claim **9**, further including sealing means around the point of contact of said first and second contact means, including a first tubular element attached to said first contact means and a second tubular element which makes a separable seal with said first tubular element attached to said second contact means so that said first and second tubular elements can separate when said contact means move away from each other.

11. A circuit-interrupting device as defined in claim **10** wherein said biasing means for said first contact means is a spring element.

12. A circuit-interrupting device as defined in claim **11**, wherein said spring element is a strong cup spring.

13. A circuit-interrupting device as defined in claim **11** herein said spring element is an annular spring.