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GAS-BLAST CIRCUIT BREAKER

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Fig. 1

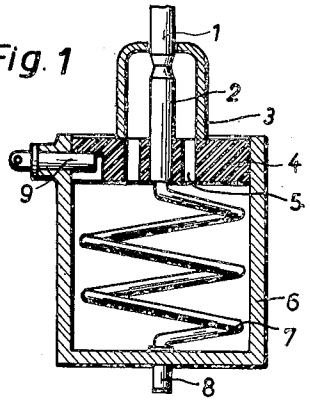


Fig. 2

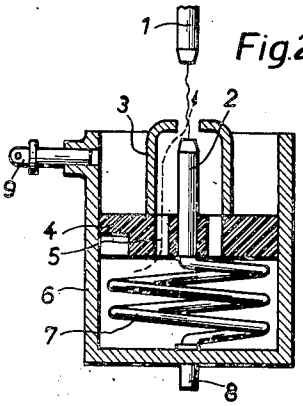
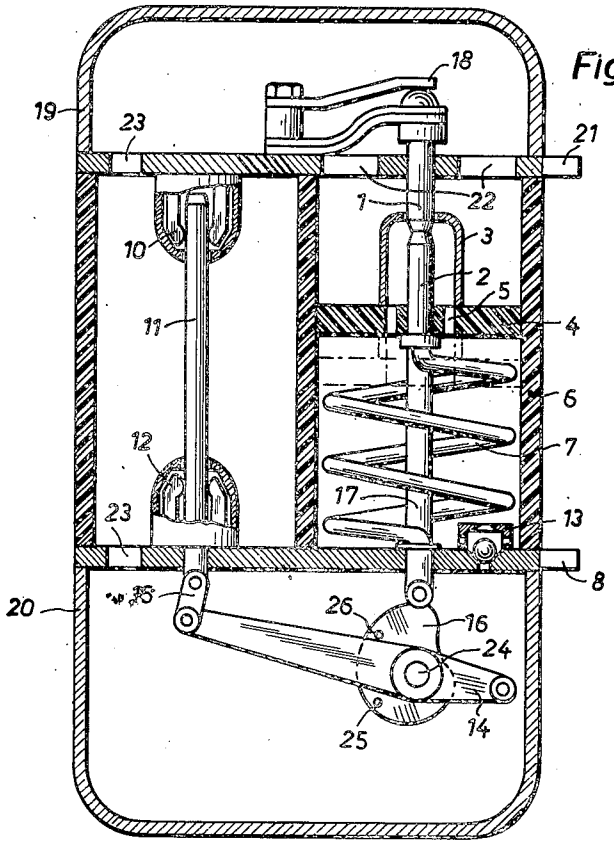


Fig. 3



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GAS-BLAST CIRCUIT BREAKER

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1 Claim. (Cl. 200—148)

It is known to extinguish arcs formed between separable contacts in circuit breakers and load disconnecting switches by blowing them with a stream of pressure-gas. Several methods are known for producing a pressure-gas blast. For example, the gas can be brought to a high pressure by a compressor and stored in a tank. The blowing of the contact gap is initiated, upon operation of the switch, by appropriate valves. It is also known to produce the pressure gradient necessary for the blowing by the arc itself, by first striking an auxiliary arc, whereby the gas compressed by heating is directed to the gap. It has further been proposed to produce the pressure-gas blast by means of a mechanically operated piston in proximity of the point of interruption.

The above-mentioned blasting methods are used, particularly in the case of air-blast circuit breakers. In the latest developments of gas-blast circuit breakers, use is made more and more of electro-negative gases which require a modification of the construction of the breakers, so that new problems have also arisen in connection with producing of the blast.

Breakers using an electro-negative gas as extinguishing fluid require a closed gas circuit; the gas used for blowing has to be recovered in specially formed breaker parts or casings for repeated use. Therefore it is advantageous to provide compact blast devices which can be disposed as completely as possible within the breaker casing. Moreover, the substantially improved extinguishing characteristics of the electro-negative gas as compared with air enable even in the case of high circuit breaking capacity, to avoid the use of compressors and to operate with the blast energy which can be produced by the switching operation itself. However, the prior devices for self-blasting have the following, fundamental disadvantages.

When energy for blasting is produced by means of auxiliary arcs, the gas to be used for the blast is already ionized and can be used for relatively small circuit breaking capacities only.

The production of the blasting energy by means of a compressor piston avoids this disadvantage, but it requires considerable power to produce a sufficient blast effect.

It is an object of the present invention to provide a gas-blast circuit breaker having fixed and movable contacts and a blast nozzle surrounding the movable contact, and in which an arc extinguishing flow of preferably electro-negative gas is dependent on the current to be interrupted and produced by the switching-off operation, the energy for the extinguishing flow being at least in part due to electromagnetic forces generated by the current to be interrupted.

An embodiment of the invention is illustrated by way of example in the accompanying drawing in which:

FIG. 1 is a diagrammatic section of the fundamental structure of the arc extinguishing device of the compressed gas circuit breaker shown in closed-circuit condition;

FIG. 2 represents the device of FIG. 1 in off position;

FIG. 3 is a simplified section of a compressed gas circuit breaker having relieving contacts connected in parallel with the arc extinguishing device.

Referring to FIGS. 1 and 2, **1** designates the stationary contact and **2** the movable contact of the circuit

breaker. The movable contact **2** and the surrounding blast nozzle **3** are rigidly connected with a piston **4** having a passageway **5** therethrough. The piston is movable in a cylinder **6** and can be locked in its raised position, corresponding to the closed circuit condition by a pawl **9**. The cylinder **6** is filled with an electro-negative gas and is influenced by a tension spring **7** made of an electrically conductive material and positioned between the piston **4** and a terminal **8** fixed to the cylinder bottom.

When the circuit breaker is switched off, the pawl **9** is released to disengage the piston (see FIG. 2). The spring **7** pulls the piston **4** downwards, whereby the contacts **1** and **2** are opened. At the same time the gas in the cylinder **6** is compressed and flows in the direction of the arrow through the aperture **5** and the nozzle **3**, extinguishing the arc between the contacts **1** and **2**. As long as the arc is lighted, the electric current flows from contact **1** to contact **2** and therefrom over the spring **7** to the lower terminal **8**. While small currents barely cause any supplementary force to be exerted on the spring windings and accordingly the extinguishing flow has to be produced practically by the spring energy alone, higher currents, occurring for example when a short circuit is switched-off, produce considerable electro-dynamic forces between the spring windings, which forces are transmitted as additional compression forces onto the piston **4**.

The described device accordingly allows to considerably increase the switching-off capacity when excess currents occur. To a certain extent, the extinguishing flow is dependent on the current in that the blast effect is smaller in the case of small currents whereby the breaking of small currents is avoided, which often leads to considerable excess voltages in gas-blast switches.

FIG. 3 shows a practical embodiment of a switch constructed in accordance with the described principle of extinction. The outer driving and releasing mechanism and the insulation against ground are not shown and the switch is represented in its closed-circuit condition.

The proper breaking mechanism again consists of members **1** to **7** and is fundamentally constructed in the same manner as shown in FIGS. 1 and 2. A blade spring **18** provides the necessary contact pressure between the fixed and movable contacts **1** and **2**. A disconnector comprising a stationary upper contact **10**, a movable contact stud **11** and a sliding contact **12** is mounted parallel with the circuit breaker. A check valve **13** is arranged in the bottom of the cylinder **6**. The piston **4** and the contact **2** of the breaker, as well as the contact stud **11** of the parallel disconnector, are operated by an actuating mechanism including a lever **14** having one end thereof connected to the contact stud **11** by an articulated link **15**. The lever **14** is journalled on a pin **24** on which is rotatably mounted a cam **16**. A cam follower rod **17** is connected to the piston **4** and is applied against the periphery of the cams by the tension of the spring **7** acting on the piston. The lever **14** can effect a limited angular movement relatively to the cam **16** between the two stop pins **25** and **26** carried by the cam. The entire breaking mechanism is disposed in a gas-tight container, the middle part **6** of which consists of insulating material, while the cap **19** and the bottom portion **20** may be metallic. The upper contacts **1** and **10** are connected electrically to each other and to the terminal **21**. The sliding contact **12** and the current carrying spring **7** are electrically connected to the lower terminal **8**. The entire container **6**, **19** and **20** is filled with an electro-negative gas, such as sulfohexafluoride SF_6, which preferably is under pressure.

The current leading parts of the switch are dimensioned in conventional manner so that in the closed-circuit condition the major portion of the current flows over the parallel disconnector **10**, **11**, **12**, while the current path of the breaker **1**, **2**, **7**, **8** is only temporarily traversed by

the total current, namely during the switching-off procedure. In order to open the circuit breaker, the right hand end of the lever **14** is turned upwardly, i.e. in counterclockwise direction, whereby the contact stud **11** is pulled out of the fixed contact **10** by the link **15**. When upon further rotation the lever **14** abuts against the stop pin **25**, the cam **16** pivotable on shaft **24** is also turned in counterclockwise direction. The cam follower rod **17** connected to the piston **4** is then released and the piston **4** with the contact **2** moves downwardly under the influence of the spring **7**. When the check valve **13** is closed the gas in the cylinder **6** can only escape upwards through the aperture **5** in the piston and the nozzle **3**, and extinguishes the arc which is struck between the two opening contacts **1** and **2**. After arc extinction and breaking of the circuit, the pressure is equalized in the container through the apertures **22** and **23**.

When small currents are to be interrupted, the piston **4** moves under the influence of the initial tension of the spring **7** into the position shown with dotted line in FIG. 3, the resulting feeble extinguisher stream being sufficient for the extinction of the arc. In the case of high currents, such as short-circuit currents, the spring **7**, owing to the electromagnetic effect of the current traversing the spring, vigorously pulls the piston into its lowermost position, whereby the gas-blast is considerably increased.

In order to close the circuit breaker, the right hand side of the lever **14** is moved downwardly, whereby the contacts **10**, **11** of the parallel disconnector are closed by the link **15**. When the movement of the lever **14** in clockwise direction continues, the cam **16** is turned along by the lever **14** abutting against the stop pin **26** on the cam and the contacts **1** and **2** of the breaker are closed again by the rod **17**. During the closing operation, when the piston moves upwards, the cylinder **6** is refilled with extinguishing gas supplied through the check valve **13**.

I claim:

A gas-blast circuit breaker comprising a pair of separable abutting arcing contacts, a blast nozzle surrounding the movable contact, means for separating said contacts to provide a gap therebetween, means for producing an arc extinguishing gas-blast through said nozzle, said gas-blast producing means including a gas filled chamber, a piston movable in said chamber, said movable contact and the surrounding blast nozzle being rigidly secured to said piston, said piston having a passageway for establishing communication between said gas-filled chamber and the blast nozzle, a coil spring of electrically conductive material operatively connected with said piston and traversed by the current to be interrupted, said coil spring being a tension spring having an initial tension when the circuit breaker is in its closed condition, a retractable stop means, said piston being held in abutment on said stop means by the tension spring when the circuit breaker is in its closed condition, said tension spring acting on said piston when the contacts are separated and an arc-extinguishing blast is generated and also current responsive electrodynamic forces generated in said coil spring acting on said piston, said arc extinguishing blast being generated in response to the current traversing said coil spring.

References Cited by the Examiner

UNITED STATES PATENTS

1,050,493	1/1913	Schweitzer et al.	200—147 X
1,827,430	10/1931	Greenwood	200—87
1,827,940	10/1931	Greenwood	200—87
2,733,316	1/1956	Brown et al.	200—148
2,934,619	4/1960	Freunt	200—87

FOREIGN PATENTS

224,667	10/1959	Australia.

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