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HIGH-TENSION CIRCUIT BREAKER

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Fig. 1.

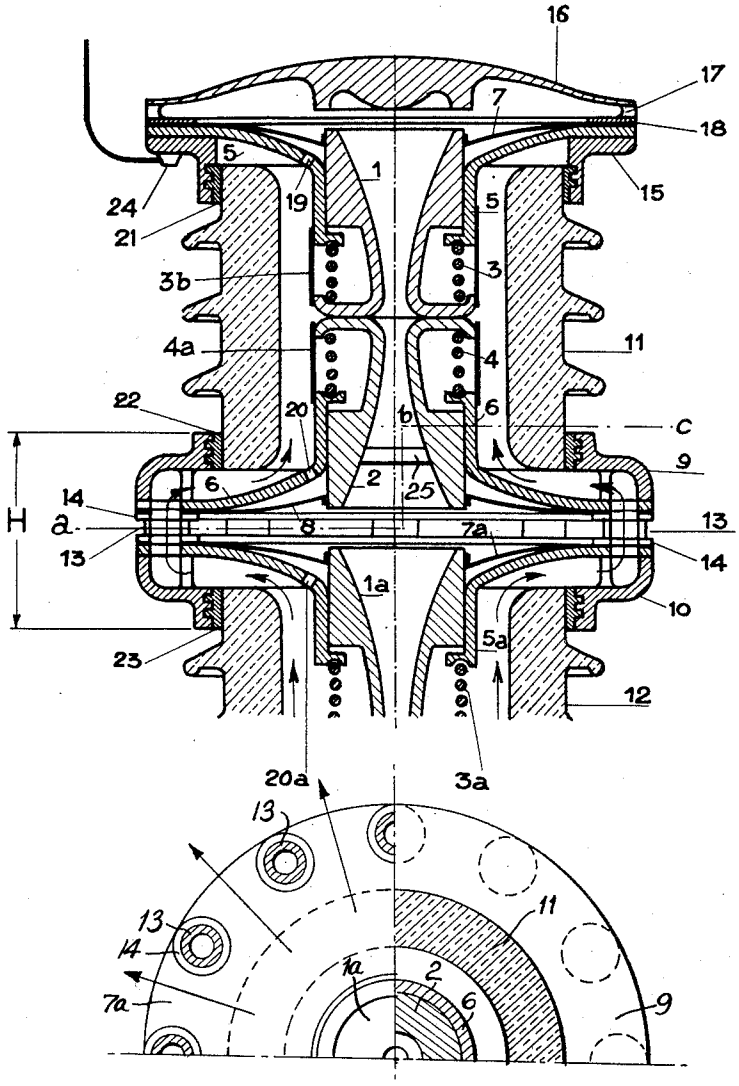





Fig. 2.

INVENTOR:
Albert Thibaudat

By: Arthur Graham

His Agent

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## HIGH-TENSION CIRCUIT BREAKER

Albert Thibaudat, Saint-Denis, France, assignor to Forges et Ateliers de Constructions Electriques de Jeumont, Paris, France, a corporation of France

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9 Claims. (Cl. 200—148)

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This invention relates to high tension circuit breakers.

In the design of high tension and extra-high tension circuit-breakers with compressed air blow-out, it is necessary not only to provide satisfactory breaking power, but also to fulfil several other conditions, and more particularly economy of compressed air, simplicity and robustness, the possibility of direct tests in testing stations, etc.

The present invention has for its main object to solve all these problems and to obtain several other advantages of practical importance by an improved arrangement of several individual breaking units juxtaposed and arranged in series.

The invention has likewise for its object to constitute each unit by a double nozzle with centripetal air inlet and axial air outlet, these nozzles being supported elastically in the interior of hollow metal elements which are separated from one another by tubular insulators.

Another object of the invention is to arrange these hollow metal elements and their insulators in such a way as to form a hollow vertical column which supports and insulates all the individual breaking units.

One of the objects of the invention is likewise to ensure in a very simple and efficient manner the desirable economy of compressed air.

Among the other objects of the invention, there may be mentioned an arrangement of the exhaust openings such that external flash-overs started by ionized gases shall be avoided and that the discharge of compressed air shall be interrupted after final extinction of the arcs.

The improved arrangement according to the invention greatly facilitates and simplifies the application of various other improved means, relating in particular to the structure of the elementary breaking units, to their association with a view to reducing the total height of the apparatus, to their operation, and so on.

As a result of all these improvements, the invention provides simple and robust apparatus, very effective and adapted to support high working currents; each individual breaking unit can offer the maximum breaking power adapted to be furnished by a good testing station, as well as a current rating sufficient for this individual breaking unit to be capable of use separately as a powerful circuit-breaker for moderate tension.

The description given hereinafter relates to an embodiment of the improved circuit-breaker of which the upper portion of one complete pole

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is shown diagrammatically in section in the accompanying drawing.

In this drawing, Fig. 1 is a part vertical section of the apparatus, and Fig. 2 is a horizontal section of Fig. 1 on the broken line *a*—*b*—*c*.

In this apparatus, one individual breaking unit comprises two movable nozzles 1 and 2 adapted to slide in the axial direction. When the circuit-breaker is closed, these nozzles are in direct contact with one another, as shown, under the pressure of the springs 3 and 4, which bear upon shoulders provided for this purpose upon guide members 5 and 6, the springs being surrounded by protective sleeves 3*b* and 4*a* which are supported by the guide members. These members 5 and 6 are rigid, indeformable and arranged to prevent any warping or wedging of the movable nozzles 1 and 2.

The next individual breaking unit comprises two movable nozzles, arranged like those of the uppermost unit, one of these nozzles being shown at 1*a*, with its spring 3*a* and its guide member 5*a*.

To each of the nozzles 1, 2, 1*a* etc., there is attached by welding for example, a flexible metal diaphragm 7, 8, 7*a*, etc. respectively, the diaphragms being of circular shape, either flat or undulated. These diaphragms, as well as the guide members 6 and 5*a*, are clamped between flanges 9 and 10 attached to two tubular insulators 11 and 12. Clamping is effected with interposition of tubular spacer elements 13 and rings 14; the clamping means, such as bolts, screws or the like, have not been represented, in order to simplify the drawing. At the top of the apparatus, the clamping of the guide member 5 and diaphragm 7 is ensured by a flange 15 and an end cover 16 having spaced teeth 17 which press upon an interposed ring 18; at the lower extremity of the apparatus, a similar cover holds the bottom guide member and diaphragm against the flange of the lowest insulator.

The spacer elements 13 are constituted by short metal tubes placed at suitable distances apart in alignment with corresponding air-holes provided in the guide members 6 and 5*a*, as well as in the flexible diaphragms 8 and 7*a*, and in the rings 14.

Fig. 2 shows the arrangement of the elements 13, 14 in relation to the flexible diaphragm 7*a* and other parts.

The guide members 5, 6, 5*a*, etc. contain small orifices 19, 20, 20*a*, etc. respectively, the purpose of which will be explained hereinafter.

The metal flanges 9, 10, 15, etc. are attached to the porcelain or like insulators 11, 12, etc. by any

suitable means; in Fig. 1, there are indicated by way of example suitable seals **21**, **22** and **23**.

It has been found that with this arrangement, the height of each metal part, designated by H in the drawing, may be very small and that the height of an individual breaking unit is practically equal to the axial length of the double nozzle. In other words, the total height of the entire pole of the circuit-breaker is reduced to the minimum compatible with the needs of insulation.

The apparatus is represented in Fig. 1 in the closed-circuit position. The current which enters at the terminal **24**, passes through the flexible metal diaphragm **7**, the nozzles **1** and **2**, the diaphragm **8**, the spacer members **13**, the diaphragms **7***a*, the nozzles of the next individual breaking unit, and so on to the bottom of the column. It will be seen that this mode of construction allows the suppression of all special connections between the circuit breaking units.

In the course of operation, compressed air, for which a passage is opened as usual through an air-valve (not shown) mounted in the base of the apparatus, fills the vertical column by passing in the direction of the arrows through the tubular spacers **13** between adjacent breaking units, the number of spacers **13** at each level being sufficient for the loss of head to remain negligible.

When the air-pressure in the interior of the apparatus increases sufficiently, the air compresses the springs **3**, **4**, **3***a*, etc. and separates the nozzles so as to strike arcs between the elements **1** and **2** of the top breaking unit, as well as between the corresponding pairs of nozzles of the other units. This movement of the nozzles is slowed down by the drop of pressure in the respective spaces which are enclosed between the flexible diaphragms **7**, **8**, **7***a*, etc. and the rigid guide members **5**, **6**, **5***a*, etc., the diaphragms acting like suction pistons. The drop of pressure thus created is only slowly compensated by the entry of air through the orifices **19**, **20**, **20***a*, etc.

By appropriate selection of the size of these orifices, and of the movable masses to be accelerated, it is possible to provide for suitable speeds of opening the contacts.

The purpose of the orifices **19**, **20**, **20***a*, etc. is therefore to regulate the speed of separation of the nozzles and to avoid any tendency to fluttering or hammering of the contact surfaces; these orifices may be adjustable in area.

The various compression springs **3**, **4**, **3***a*, etc. may be regulated in such a way that the separation of the nozzles in the several breaking units takes place simultaneously.

The compressed air passes thereafter along the nozzle bores, effects the blow-out of the arcs and escapes radially to the free air between the teeth **17** of the end covers and between the spacers **13** at the intermediate levels. In Fig. 2, this escape of air is indicated by radial arrows. At the limit of their stroke, the nozzles **2** and **1***a* of adjacent breaking units touch one another, while the nozzle **1** of the top unit abuts against the cover **16**, so that the discharge of air is greatly reduced or completely stopped, and air-pressure is maintained in the interior of the apparatus.

The apparatus may comprise any suitable means (not shown) for protecting its interior against rain and snow. There may be provided for this purpose hinged or flexible shutters which are normally closed and which open in the course of operation of the circuit-breaker by the effect of the air-discharge.



There have not yet been mentioned any electrodes intended to limit the length of the arcs. It is obvious that there is nothing to prevent the application of means of this kind, but in the example considered, the co-axial alignment of the nozzles allows, if desired, the total suppression of such means. If such electrodes are not used, the length of the individual arcs formed in each pair of nozzles is not defined or limited. These individual arcs can therefore join up and reach to the end parts of the circuit breaker, such as the top cover **16** and a corresponding member (not shown) at the other end of the apparatus.

It will then follow that a single arc can be formed between the end covers (cover **16** at the top and corresponding member at the other end); such single arc, traversing all the nozzles in series, can be blown out at several levels.

If, on the contrary, such a single arc is not desired, the electrodes mentioned above may be provided so as to limit the length of the individual arcs, as shown for example by the element **25** in Fig. 1.

What I claim is:

1. A high tension compressed air circuit-breaker of the multiple break type, formed by a plurality of interrupting units connected in series, each unit comprising a pair of pneumatically operated axially slidable nozzles adapted for contact making, elastic means for establishing contact between said nozzles, guiding means for said nozzles, said guiding means having the form of cylinders provided with rigid flanges, elastic diaphragms arranged as electrical connections to said nozzles and adapted to form with said rigid flanges elastic walled cavities, means for slowly filling said cavities with compressed air, assembling means comprising a tubular insulator surrounding said nozzles and guiding means, metallic flange elements upon the ends of said insulator attached to said rigid flanges and to said elastic diaphragms so as to form a vertical column assembling all said interrupting units, a plurality of registering passages through the peripheries of said flanges and diaphragms, and metallic spacing elements between said rigid flanges, said spacing elements having the form of short tubes located co-axially with said passages to provide air channels between the respective interrupting units, said metallic spacing elements also forming electrical interconnections between said interrupting units, air outlets between said spacing elements, and air flow stopping means comprising abutments adapted to close said nozzles at the ends of their respective opening movements.

2. In a high tension circuit breaker according to claim 1, means for regulating the air inlet into said elastic walled cavities in order to control the speed of separation of said slidable nozzles, said regulating means comprising restricted apertures for inlet of air into said cavities.

3. In a high tension circuit breaker according to claim 1, intermediate nozzles having their outlet ends adapted to form mutual stops, and separate stationary abutments for the outlets of the end nozzles, whereby the air flow is stopped at the end of the opening movement of all the nozzles.

4. In a high tension air flow circuit-breaker, a plurality of individual breaking units, each unit comprising a pair of axially movable contact making nozzles of the conventional centripetal inlet and axial outlet type with inner arc-length limiting electrodes, a pair of rigid flanged guiding elements for said movable nozzles, a pair of

circular flexible metallic diaphragms sealed to the peripheries of said guiding elements as well as to said nozzles and arranged as current conducting elements, said guiding elements being provided with small openings for regulating the entry of air into the spaces between said guiding elements and said diaphragms in order to control the opening movement of said contact making nozzles, a pair of compression springs interposed between said nozzles and said guiding elements and adapted to close the contacts of said nozzles, a tubular insulator surrounding each of said individual breaking units, hollow metal assembling flanges secured to the ends of said insulators, tubular metallic spacing elements interposed between the flanges of adjacent guiding elements, said spacing elements registering with air passage openings in said guiding elements and said diaphragms, plain metallic flanges secured to said insulators at the ends of said high tension circuit-breaker, and metallic end pieces connected to said plain metallic flanges, said end pieces being provided with spaced exhaust openings.

5. In a high tension circuit-breaker, according to claim 4, means for interrupting the air flow after a current interruption, comprising abutments adapted to close the nozzle outlets at the ends of the respective nozzle movements.

6. A high tension circuit-breaker of the type having multiple breaks and compressed air blow-out, comprising a plurality of individual breaking units assembled in a column and arranged in series, each of said breaking units including a pair of axially slidable contact-making nozzles, rigid flanged guides for said nozzles, springs urging said nozzles into contact with one another, flexible diaphragms conductively connected to said nozzles and sealed to said rigid flanged guides in order to form elastic-walled cavities, throttling devices in said guides for slowly filling said cavities with compressed air, a tubular insulator surrounding said nozzles and guides, metallic assembly flanges attached to the ends of said insulator, means for connecting said assembly flanges to the flanges of said guides and to the peripheries of said diaphragms, and tubular spacing means for passing compressed air upwardly of said column between the respective tubular insulators and the nozzles and guides therein.

7. A high tension circuit-breaker of the type having multiple breaks and compressed air blow-out, comprising a plurality of individual breaking units assembled in a column and arranged in series, each of said breaking units including a pair of axially slidable contact-making nozzles, rigid flanged guides for said nozzles, springs urging said nozzles into contact with one another, flexible diaphragms conductively connected to said nozzles and sealed to the peripheries of said guides in order to form elastic cavities, means for slowly filling said cavities with compressed air in order to control the opening speed of said contact making nozzles, a tubular insulator surrounding said nozzles and guides, metallic assembly flanges attached to the ends of said insulator, means for connecting said assembly flanges to the flanges of said guides and to the peripheries of said diaphragms, and means for passing compressed air upwardly of said column between the respective tubular insulators and the nozzles and guides therein, said air passing means including tubular metal spacers interposed between the peripheries of adjacent diaphragms, with the bores of said spacers registering with openings in said peripheries and in the flanges of said guides.



8. A high tension circuit-breaker of the type having multiple breaks and compressed air blow-out, comprising a plurality of individual breaking units assembled in a column and arranged in series, each of said breaking units including a pair of axially slidable contact-making nozzles, rigid flanged guides for said nozzles, springs urging said nozzles into contact with one another, flexible diaphragms conductively connected to said nozzles and sealed to the peripheries of said guides in order to form elastic cavities, means for slowly filling said cavities with compressed air in order to control the opening speed of said contact making nozzles, a tubular insulator surrounding said nozzles and guides, metallic assembly flanges attached to the ends of said insulator, means for connecting said assembly flanges to the flanges of said guides and to the peripheries of said diaphragms, and means for passing compressed air upwardly of said column between the respective tubular insulators and the nozzles and guides therein, said air passing means including tubular metal spacers interposed between the peripheries of adjacent diaphragms, with the bores of said spacers registering with openings in said peripheries and in the flanges of said guides, and said spacers being arranged at peripheral intervals to leave free gaps for exhaust of air discharged through the nozzles to which the said diaphragms are conductively connected, and to act as electrical connections between said interrupting units.

9. A high tension circuit-breaker of the type having multiple breaks and compressed air blow-out, comprising a plurality of individual breaking units assembled in a column, each of said breaking units including a pair of axially slidable contact-making nozzles, rigid flanged guides for said nozzles, springs urging said nozzles into contact with one another, flexible diaphragms conductively connected to said nozzles and sealed to the peripheries of said guides in order to form elastic cavities, means for slowly filling said cavities with compressed air in order to control the opening speed of said contact making nozzles, a tubular insulator surrounding said nozzles and guides, metallic assembly flanges attached to the ends of said insulator, means for connecting said assembly flanges to the flanges of said guides and to the peripheries of said diaphragms, and means for passing compressed air upwardly of said column between the respective tubular insulators and the nozzles and guides therein, with means for exhaust of air discharged through the end nozzles, said exhaust means including an apertured end-piece, said end-piece being secured to the assembly flange at the end of the last tubular insulator together with the periphery of the diaphragm and the flange of the guide appertaining to the end nozzle.

ALBERT THIBAUDAT.

No references cited.