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COMPRESSED-GAS MULTI-BREAK CIRCUIT-INTERRUPTER HAVING CYLINDRICAL CHAMBERS WITH ECCENTRIC CONTACTS

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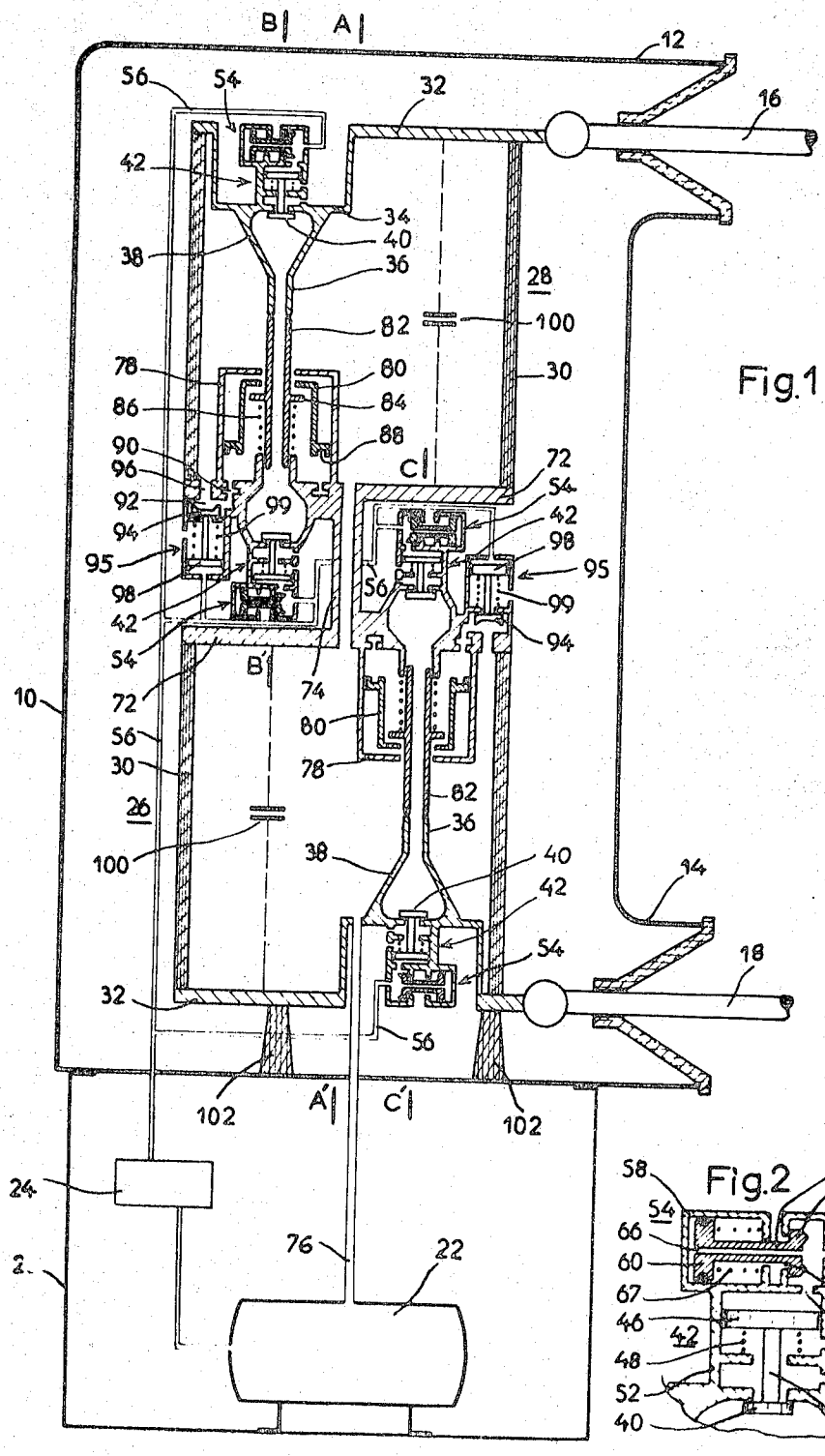

Fig.1

Fig.2

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COMPRESSED-GAS MULTI-BREAK CIRCUIT-INTERRUPTER HAVING CYLINDRICAL CHAMBERS WITH ECCENTRIC CONTACTS

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ABSTRACT OF THE DISCLOSURE

A multiple-break, compressed gas circuit-interrupter pole unit having longitudinally aligned arc extinguishing chambers of insulating material. To reduce the overall length, the axes of the contact means of successive chambers are staggered to permit overlapping of members associated with the contact means, successive chambers are staggered to permit overlapping of members associated with the contact means, such as exhaust valves or contact movement control means.

The present invention relates to a compressed-gas, multiple-break circuit-interrupter comprising at least two arc-extinguishing chambers connected electrically in series and the generally cylindrical enclosures of which are of insulating material and longitudinally aligned on a common axis, the enclosure of each chamber being filled with compressed gas and containing a set of separable contact means.

The development of high-voltage metal-clad installations in which the electrical apparatus is arranged within grounded metallic casings permits to obtain a reduction of the overall size of the switching stations and also an increased safety since the live parts are not directly accessible. Furthermore, the arrangement of the arc-extinguishing chambers of a circuit-interrupter in gas-tight enclosures makes it possible also to use special dielectric gases such as sulfur hexafluoride which have a dielectric strength greater than that of air while some of these gases have very interesting arc extinguishing properties which make it possible to considerably increase the breaking power of the circuit-interrupters. The use of grounded metallic casings around the extinguishing chambers makes it possible to recover the compressed gases which served for the extinguishing of arcs in the chambers, which is advantageous in view of the cost price and often necessary for reasons of toxicity of the gas. However, in the general case of high voltage circuit-interrupters with a plurality of extinguishing chambers, the alignment of the conventional chambers in which the contacts are arranged in the axis of the chambers determines a total length of the casings and therefore an overall size of the stations, which was still considered to be excessive in view of the price of the installation on the one hand and the space occupied by the installation, particularly in urban centers, on the other hand.

An object of the invention is to provide a compression gas high-voltage circuit-interrupter with multiple chambers, the size of which is substantially reduced as compared with the size of the conventional multi-break circuit-interrupters in which the total length of the apparatus is equal to or greater than the sum of the lengths of the individual chambers.

These and other features and advantages will become apparent from the following description of one embodiment of the invention with reference to the accompanying drawing in which:

FIG. 1 shows schematically a pole of a metal-clad circuit-interrupter seen in elevation and in axial section, and

FIG. 2 is an axial view on a larger scale through a pneumatic time-delay relay.

In the example selected, the circuit-interrupter is of the metal-clad type with a pair of extinction chambers connected electrically in series, but it is obvious that a greater number of chambers in series can be used. Moreover, while the application of the invention seems to be of particular interest in the case of a metal-clad circuit-interrupter, its use in a nonshielded circuit-interrupter without outer enclosure also appears advantageous.

The circuit-interrupter shown in the drawing comprises a cylindrical outer casing **10** consisting of a grounded metal envelope having two cylindrical connections **12** and **14** supporting axial input and output conductors **16** and **18**, respectively.

The casing **10** is supported on a base **20** which contains a compressed gas source or tank **22**; a pneumatic control device schematically shown at **24**; and possibly other control and signaling members; etc., which do not form the object of the present invention. In the example selected to illustrate the invention, the active parts of the circuit-interrupter are actuated pneumatically but it is understood that this actuation may also comprise hydraulic, mechanical, optical or hertzian transmissions, etc., or combined systems.

Two arc-extinguishing chambers, designated generally by the numerals **26** and **28**, are superimposed longitudinally and coaxially in the casings **10**. Each chamber comprises a cylindrical outer enclosure **30** of insulating material arranged coaxially with the casing **10**, the axis A–A′ being common to the casing **10** and to the enclosures **30**. End plates **32** of conductive material close the opposite ends of the chambers **26** and **28** and are electrically connected to the conductors **16** and **18**, respectively. Each plate **32** has a cavity **34** penetrating into its chamber to support a fixed tubular contact **36** via a hollow frustoconical conduit **38**. The valve members **40** of a first exhaust valve **42** makes it possible selectively to connect the inside of the conduit **38** and of the contact **36** with the inside of the casing **10** and the support rod **44** of the valve member **40** is connected to a control piston **46** which is biased by a compression spring **48** which tends to close the valve member. Via an opening **50** provided in the valve body **52**, the active face of the piston **46** can be exposed selectively to a high pressure and a low pressure in order respectively to open and close the valve member **40**, a pneumatic time-delay relay **54**, shown in further detail in FIG. 2, making it possible to reclose the valve member **40**, after a short period of time following the pressurizing of a control piping **56** which is connected to the control valve **24** which may, for instance, be operated manually or electrically. The pneumatic time-delay relay **54** comprises a first cylindrical body **58** which contains a control piston **60** which is rigidly connected with a valve member **62** by a rod **64**. A passageway **66** extends through the valve member **62**, the rod **64** and the piston **60** in its entirety and terminates behind the piston, and the compression spring **67** biases the piston backwards. The valve member **62** moves within a second cylindrical body **68** the inside of which can communicate on the one hand with the control piping **56** and on the other hand, via the orifice **50**, with the inside of the valve body **52**, depending on the position of the valve member **62**. The latter may uncover an opening **70** which provides communication between the inside of the valve body **52** and the inside of the casing **10** and then establish a gas-tight connection between the passage **66** and the

piping 56 and, in its opposite position, connect said piping with the inside of the body 52.

A second conductive plate 72 closes off the opposite end of each chamber and is traversed by a pipe 74 of conductive material which assures electric continuity between the two chambers and permits the chamber 28 to be fed with compressed gas from the chamber 26 which in its turn is supplied from the tank 22 by an insulating pipe 76.

Each plate 72 bears a fixed cylinder 78 containing a control piston 80 in the shape of a cap which is intended to drive along with it a movable tubular contact 82 in cooperation with a collar 84 on the contact 82. A compression spring 86 biases the contact 82 towards its closed circuit position and a rim 88 on the piston cooperates with a passageway 90 which it can close and which opens into a space 92 which a valve member 94 of a control valve for the movement of the moving contact, designated generally by the numeral 95, and cooperating with an opening 96 in the plate 72, can selectively place out of and under pressure by means of its control piston 98. Piston 98, in its turn, is controlled by the pressure prevailing in the control piping, schematically shown at 56, and is biased to its initial position by a compression spring 99.

The axis B–B′ of the tubular contacts 36, 82 of the chamber 28 and the axis C–C′ of the contacts 36, 82 of the chamber 26 are offset one with respect to the other and located on opposite sides of the axis A–A′ in order to permit the staggering and overlapping of the members 42, 54 of the two chambers, this resulting in a decrease in the overall length of the chambers and in the height of the circuit-interrupter. The space freed by the off-centered contacts is advantageously occupied by voltage-dividing capacitors, shown schematically at 100, which act to distribute the potential evenly between the different chambers. It is also possible to locate auxiliary breaking resistors and interrupter means thereof in this space. The chambers 26 and 28 are supported within the enclosure 10 in suitable fashion, for instance by insulators 102.

A brief description will now be given of the operation of this circuit-interrupter.

When the circuit-interrupter is in the position shown with its contacts 36, 82 closed, the envelopes 30 of the chambers 26 and 28 are filled with a gas compressed to a high pressure (for example 14 bars) supplied by the tank 22. The hermetic enclosure 10 which surrounds these chambers is subjected to a low pressure (for instance 3 bars), while a compressor (not shown) takes low pressure gas from the enclosure 10 and delivers it at high pressure into the tank 22 in known manner. This closed circuit of the gas which is recycled by the compressor which can be controlled by temperature-compensated manostats has the aforementioned advantages, to which one could further add the advantage of the impossibility of atmospheric moisture being introduced into this independent circuit.

The valves and relays 42, 54 and 95 are, in the position shown, under the action of their return springs 48, 67 and 99. The control piping 56 is without pressure or under low pressure due to the position of the control valve 24.

The current passes through this closed circuit-interrupter along the following path: conductor 16, plate 32, conduit 38, fixed contact 36, movable contact 82, cylinder 78, plate 72 (all these parts being associated with the extinguishing chamber 28), pipe 74, chamber 26 (plate 72, cylinder 78, contacts 82 and 36, conduit 38, plate 32 thereof) conductor 18.

In order to open the circuit-interrupter and interrupt the current the valve 24 is actuated to place the piping 56 under high pressure. This results in the opening of the contacts 82 to draw arcs and in the opening for a brief instant of the exhaust valves 40 which establish temporary communication between the inside of the tubular contacts 36 and 82 on the one hand and the inside of the low-pressure casing 10 on the other hand. The compressed gas contained in the envelopes 30 surges into these open contacts 36 and 82, blowing the arc energetically and extinguishing is, while escaping into the enclosure 10, whereupon the valve closure members 40, 40 close to maintain the pressure in the chambers 26 and 28. The gases collected by the tank 10 slightly increase the pressure therein and the compressor takes care, obviously, of the re-establishing of the initial pressure upon a subsequent operation.

The control of the moving contacts and of the exhaust valves will now be described: the pressurizing of the piping 56, which is maintained as long as the circuit-interrupter is to remain open, causes the pressurizing of the pistons 98 of the valves 95 and the closure of the valve members 94 which cover the openings 96 and uncover a passageway which provides communication between the spaces 92 and the low pressure of the enclosure 10. The spaces located behind the pistons 80 are then placed under low pressure so that these pistons whose opposite faces are exposed to the high pressure of the chambers 26 and 28 move so as to strike against the collars 84 thereby opening the movable contacts 82. At the end of the stroke, the annular valve members 88 of the pistons close the passageways 90.

At the same time, the action of the pressure on the pistons 46 of the valves 42 causes the opening of the valve members 40. The compressed gas of the control piping 56 starts to penetrate into the calibrated passageway 66 and the pressure behind the pistons 60 starts to rise relatively slowly. When this pressure has reached a predetermined value, the value members 62 move suddenly to establish a hermetic connection between the piping 56 and the passageway 66 (permitting, so to say, self-feeding of the relay 54 with compressed gas) and in order to uncover the opening 70 which places the piston 46, via the opening 50, at the low pressure of the tank 10. This results in the valve members 40 closing again after a predetermined period of time so calculated as to permit the extinguishing of the arcs under the most unfavorable circumstances which can occur in operation.

In order to close the circuit-interrupter again, the valve 24 is actuated, to place the piping 56 under low pressure. The valves 95 open under the action of the springs 99, admitting high pressure behind the pistons 80 so that the latter regain their initial position and permit the closing of the movable contacts 82 under the action of the springs 86.

At the same time, the vacuum created in the passages 66 permits the springs 67 to return the valve members 62 to their initial position.

In the example which has been selected to illustrate the invention, the object of the invention is achieved by the staggering of the axes B–B′ and C–C′ of the contacts of the chambers 28 and 26 with respect to the axis A–A′ of the chambers, combined with the staggering of the respective pneumatic members 42, 54 and 95 of the chambers. It is obvious that this object is also achieved by the staggering of other end members associated with the contacts of the respective chambers, in accordance with the specific design of the circuit interrupter. On the other hand, it is apparent, that the axes B–B′ and C–C′ of the contacts need not be parallel to the axis A–A′ and can be staggered in zig-zag, remaining substantially parallel one with respect to the other.

What is claimed is:

1. A multiple-break, compressed gas circuit-interrupter pole unit, comprising a pair of electrically series connected pressurized arc extinguishing chambers having common axis, cylindrical, longitudinally substantially aligned pressure enclosures of insulating material, each of said pressure enclosures housing arc extinguishing means substantially aligned along an axis and comprising elongated contact means separable along said axis to draw an arc, the axes of said arc extinguishing means

of said chambers being offset one with respect to the other and both with respect to said common axis whereby the confronting end portions of said arc extinguishing means of said chambers are in overlapping relation one relative to the other.

2. A pole unit as claimed in claim 1, said axes being parallel one with respect to the other.

3. A pole unit as claimed in claim 2, said axes of said arc extinguishing means being staggered alternatively on either side of said common axis, parallel thereto.

4. A pole unit as claimed in claim 1, said confronting end portions comprising at least a part of contact movement control means.

5. A pole unit as claimed in claim 4, said confronting end portions comprising at least a part of arc blast gas exhaust valves.

6. A pole unit as claimed in claim 1, further comprising a pressurized, cylindrical, conductive outer casing surrounding said enclosures coaxially.

7. A pole unit as claimed in claim 1, further comprising capacitive voltage dividers juxtaposed to said arc extinguishing means in said enclosures.

8. A pole unit as claimed in claim 1, further comprising auxiliary breaking resistor and interrupter means justaposed to said arc extinguishing means in said enclosures.

9. A multiple-break, metal-clad, double-pressure, compressed gas circuit-interrupter pole unit, comprising a pair of electrically series connected high pressure arc extinguishing chambers having common axis, cylindrical,

longitudinally aligned pressure enclosures of insulating material, a cylindrical, low pressure, electrically conductive earthed outer casing surrounding said enclosures substantially coaxially, each enclosure housing elongated contact means having an axis along which said contact means are translationally separable to draw an arc, said contact means comprising a hollow contact member in fluid communication and aligned with an exhaust valve adapted to exhaust gas from the corresponding chamber through said contact members into said casing, the axes of said contact means of said chambers being offset one with respect to the other and both with respect to said common axis whereby adjacent valves of said contact means of said chambers are laterally juxtaposed on either side of said common axis.

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