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Arnholm et al.

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- [54] **OPERATING MEANS FOR ELECTRIC SWITCHING APPARATUS FOR HIGH VOLTAGE**
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- [51] Int. Cl.....**H01h 33/80**
- [58] Field of Search.....**200/148 R, 148 B, 148 F, 200/150 R, 200/150 B**

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[57] **ABSTRACT**

In an operating device for high voltage gas blast circuit breakers, the opening impulse is transmitted from earth to high potential by means of an insulating tension rod. A high initial acceleration of the rod is obtained by suddenly evacuating a pressurized cylinder space at earth potential through an electro-dynamically operated valve.

10 Claims, 2 Drawing Figures

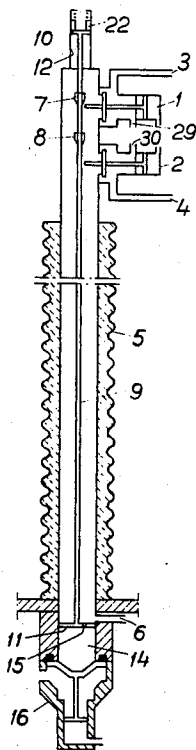


Fig 1

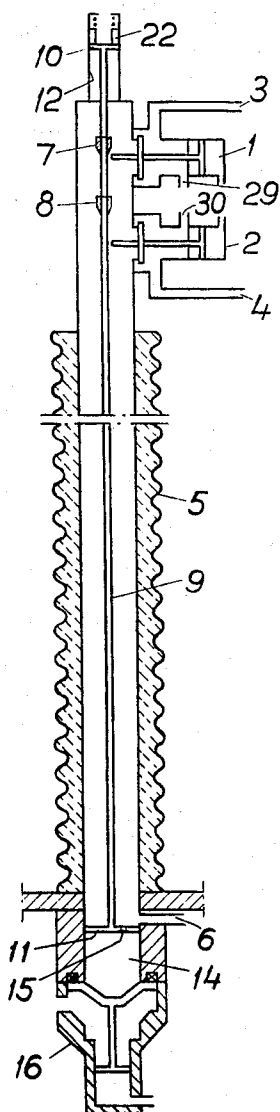
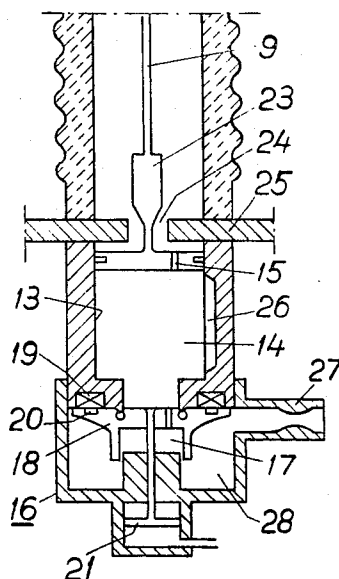


Fig 2



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OPERATING MEANS FOR ELECTRIC SWITCHING APPARATUS FOR HIGH VOLTAGE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a means for operating at least one contact in an electric switching device for high voltage and relates primarily to voltages in the order to 1,000 kilovolts. The means is of the type in which a movement impulse is rapidly transferred from earth to high potential via a tension rod.

2. The Prior Art

In the operation of switching devices for extremely high voltages, very short and exact switching times are required. This can be achieved as proposed in application Ser. No. 883,134 to Grune et al., filed Dec. 8, 1969, by using electro-dynamically operated pneumatic operating members placed in the immediate vicinity of the contacts at high potential and arranging release of the operating members from earth potential by means of an electro-optical signal transmission system. In such an arrangement, the operating energy for the electro-dynamic system must be accessible at high potential. However, it has been found both difficult and expensive to arrange the supply of this energy satisfactorily. Such an energy feeding system is not necessary if an insulating tension rod is used to transfer the required impulses from an operating member placed at earth potential to a pressurized gas valve placed at high potential to operate the contacts. In a previously known construction of this type (U.S. Pat. No. 3,420,972), the movement of the rod is effected by supplying pressurized gas to a cylinder space in which an operating piston joined to the lower end of the rod is axially displaceable. The initial acceleration which can be imparted to the rod is relatively limited in this construction and it is also difficult to regulate the speed of the rod as a function of the time. The possibility of this is particularly desirable when the rod is to be used to transmit impulses to both a power interrupter contact and a resistor interrupter contact with a certain time delay between the impulses.

SUMMARY OF THE INVENTION

The object of the present invention is to effect an operating means which in the above respects is more suitable than corresponding previously known constructions.

As in the embodiment shown in U.S. Pat. No. 3,420,972, the operating means according to the present invention comprises a pressurized gas valve placed in the vicinity of the contacts of the switching device at high potential, the movable valve member being controlled from earth potential by means of an insulated tension rod arranged inside a support insulator filled with compressed gas, the tension rod being joined to two pistons which are axially displaceable along cylindrical surfaces at the upper and lower ends of the rod, the upper side of the upper piston being in communication with the open air. The invention is characterized in the lower side of the lower piston limits a cylindrical space which communicates through a narrow opening with the support insulator filled with pressurized gas and can be connected through a high speed evacuation valve to the open air to operate the contact. By means of such a construction, with the help

of which the cylindrical space filled with pressurized gas can rapidly be placed in direct communication with the open air through an opening having a large through-flow area, an extremely rapid pressure drop is achieved in the cylindrical space, thus causing high acceleration of the tension rod even in the initial stage of the operating movement.

In order to achieve the desired rapid emptying of the cylindrical space below the lower piston during an operating movement, it is advisable to use as evacuating valve an electro-dynamically controlled pneumatic valve, since the operating time for such a valve is particularly short.

In certain switching devices it is necessary to supply power impulses to at least two contacts with a certain time delay between the impulses, but with a common release signal. For this purpose, the device according to the invention can be designed so that at least two pneumatic valves at high potential are arranged to be influenced by a number of cams supported by the tension rod. Suitable time delay between the release impulses to the various contacts can thus easily be adjusted by attaching the cams to the rod in such a way that the distance between them can be altered.

In order to achieve exact intervals between the various release impulses, it is desirable for the movement of the tension rod to be kept substantially constant after the first rapid acceleration. This can be achieved by reducing the driving force on the tension rod after a certain time, which can be realized in several different ways relatively easily, as is clear from the following description.

BRIEF DESCRIPTION OF THE DRAWINGS

The drawings show an embodiment of the invention, FIG. 1 showing the principle for transmission of the release impulses from earth to high potential, while FIG. 2 shows the operating member arranged at earth potential in closer detail.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 shows schematically two pneumatic valves 1 and 2 placed at high potential and intended to emit power impulses to a power contact and a resistor contact, respectively, in an electric switching device, for example an air balst circuit breaker. Release of the contacts is effected by opening the valves 1 and 2 so that two conduits 3 and 4 are placed under pressure from a hollow support insulator 5 filled with pressurized gas, which is fed by a conduit 6 from source of pressurized gas arranged at earth potential. The valves 1 and 2 are influenced by two cams 7 and 8 which are attached to a vertical tension rod 9 of insulating material arranged inside the support insulator 5, which rod is provided at its upper end with a piston 10 and at its lower end with a piston 11 having a larger diameter than the piston 10. The pistons are axially displaceable along cylindrical surfaces 12 and 13 at the upper and lower ends of the rod. Between the pistons and the cylindrical surfaces are sealing rings. The lower side of the lower piston 11 limits a cylindrical space 14, which is in communication with the support insulator 5 filled with pressurized gas through a leakage hole 15 in the piston 11, so that the cylindrical space 14 is under pres-

sure during normal operation. The cylindrical space 14 can be placed in communication with the open air through an electro-dynamically controlled pressurized gas valve 16.

The design of the pressurized gas valve 16 is clear from FIG. 2. In this valve the required sealing pressure is effected by pressurized gas being supplied to a space 17 on the lower side of the valve plate 18. The valve is operated by discharging a capacitor, which is charged in advance, through an induction coil 19 so that a current is induced in a short circuiting ring 20 arranged in the valve plate. As a result, the valve plate is pushed away from its seat with considerable force. At the same time, the pressurized gas in the cylindrical space 14 will operate over a greater surface of the valve plate 18, thus contributing to a shortened opening time of the valve. Closing of the valve is effected by supplying pressurized gas to a cylindrical space on the lower side of a return piston 21.

In the drawings, the tension rod 9 and evacuation valve 16 are shown in normal position, the pressure p_1 in the cylinder space 14 being equal to the pressure p_0 in the support insulator 5. The same pressure thus prevails on both sides of the lower piston 11, and the upper piston 10 will keep the rod in its upper position, pressed against resilient stops 22 by a force F which, apart from the relatively slight gravity which influences the rod and pistons, is equal to $p_0 \cdot A_2$, where A_2 designates the area of the piston 10. Upon an electric impulse, the valve 16 opens and the cylindrical space 14 is evacuated. The tension rod 9 is thus moved down under the influence of a force $F_1 = (p_0 \cdot p_1)A_1 - p_0 \cdot A_2$, where A_1 designates the area of the piston 11. During the downward movement of the rod the valve 1 is first actuated and then the valve 2, thus operating the power and resistor contacts, respectively, of the switching device. The evacuation valve 16 is then returned automatically to its normal position by admitting air below piston 21, the pressure on both sides of the piston 11 is equalized through the leakage hole 15 and the tension rod returns to its upper position under the influence of the force $F = p_0 \cdot A_2$.

If the cylindrical space 14 is emptied rapidly, the downwardly operating force on the rod will be $F_1 = p_0(A_1 - A_2)$ with a continuous acceleration of the tension rod as a consequence. In order to achieve an exact time interval between the release moments of the two contacts, however, it is desirable for the speed of the tension rod during the latter stage of the operating movement to be held substantially constant. This can be achieved with the help of a damping piston 23 on the tension rod 9 by throttling an opening 24 in a wall 25 arranged immediately above the lower piston. Further feeding of pressurized fluid to the space above the piston 11 is thus partially shut off and the driving force F_1 is reduced. Furthermore, by suitably positioned pressure equalizing grooves 26 in the cylindrical surface 13 and possibly by means of a throttled portion 27 in the outlet channel of the evacuation valve 16, the driving force of the tension rod can be further controlled in relation to the time. If such a throttle 27 is used, an out-flow space 28 should be arranged ahead of the throttle having such a large volume in relation to the cylinder space 14, that a sufficiently rapid pressure drop is obtained in the latter space when the valve 16 opens.

The valves 1 and 2 shown schematically in FIG. 1 are in principle designed in the same manner as the evacuating valve 16 shown in FIG. 2. However, instead of the electro-dynamic operating means 19, 20 of the valve 16, the valves 1 and 2 are controlled purely mechanically by means of pins actuated by the cams 7 and 8. Furthermore, the valves 1 and 2 are provided with additional valve openings 29 and 30, through which the pneumatic operating mechanism of the contacts is in communication with the open air when the valves are in normal position.

We claim:

1. Means for operating at least one contact in an electric switching device for high voltage comprising a pneumatic valve (1) placed at high potential, a hollow support insulator (5) adapted to be filled with compressed gas carrying said pneumatic valve at its upper end, an insulating tension rod (9) movable upward and downward within said support insulator, means forming cylindrical surfaces (12, 13) adjacent the top and bottom of said support insulator, upper and lower pistons (10, 11) connected to said tension rod and slidable within said cylindrical surfaces, the top surface of the upper piston being exposed to atmospheric pressure, an opening of small cross-section compared to that of the interior cross-section of the insulator support connecting the spaces above and below the lower piston, and a high speed evacuation valve (16) for connecting the space below the lower piston to atmospheric pressure.

2. Means as claimed in claim 1, having electrodynamic means for opening said evacuation valve.

3. Means as claimed in claim 1, in which the upper piston has a smaller effective area than the lower piston.

4. Means as claimed in claim 1, including means on said tension rod to operate said pneumatic valve during downward movement of the rod.

5. Means as claimed in claim 1, including two pneumatic valves, and cams on said tension rod engageable with the pneumatic valves.

6. Means as claimed in claim 5, in which the cams are adjustable along the tension rod.

7. Means as claimed in claim 1 having a wall adjacent and above the lower piston having an opening therethrough of substantially greater cross-section than the cross-section of the tension rod, the tension rod passing through the hole, and an enlargement carried by the tension rod and movable into the hole during downward movement of the rod to throttle the flow of gas from the interior of the support insulator into the space above the lower piston.

8. Means as claimed in claim 7, having grooves in the lower cylindrical surface exposed after a predetermined downward movement of the rod from its normal position for equalizing the pressure on opposite sides of the lower piston.

9. Means as claimed in claim 1 having means forming an outflow chamber on the outlet side of the evacuation valve having a throttled outlet to atmospheric pressure.

10. Means as claimed in claim 1, having grooves in the lower cylindrical surface exposed after a predetermined downward movement of the rod from its normal position for equalizing the pressure on opposite sides of the lower piston.